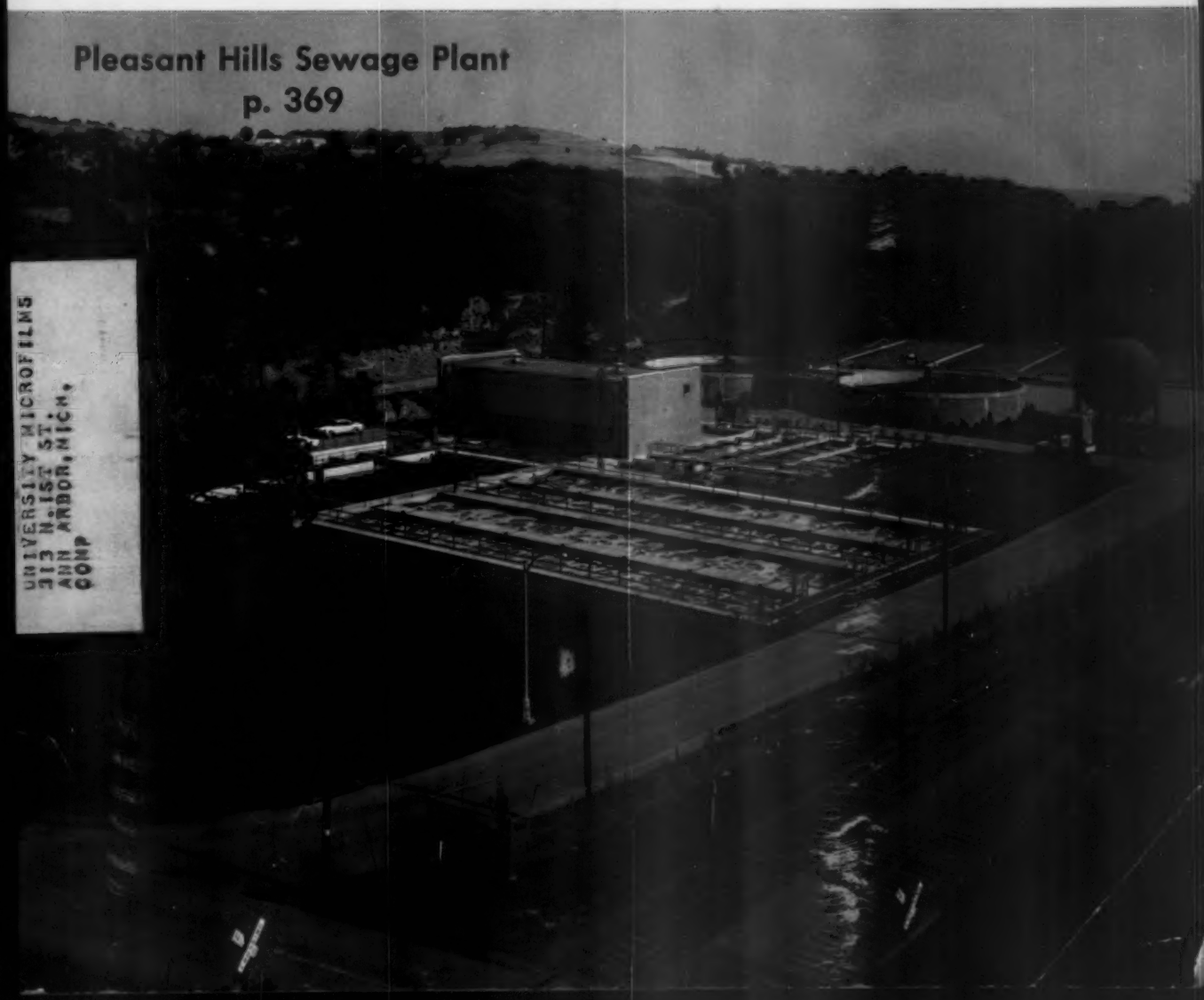
A Scranton Gillette Publication

OCTOBER 1960

WATER & SEWAGE WORKS

WATER SUPPLY • SEWAGE DISPOSAL



Pleasant Hills Sewage Plant
p. 369

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■ CB&I's experience in the design, fabrication and erection of elevated steel tanks for water storage is unmatched by anyone. In 1894, CB&I pioneered the first hemispherical bottom tank at Ft. Dodge, Iowa. With the recent erection of a 1,500,000-gallon Horton® Spheroidal for Wheaton, Illinois, CB&I's experience spans 13,512 elevated steel water storage tanks . . . and scores more are under construction. CB&I's sound experience and pioneering spirit can solve your water storage problems, too. Let us show you how.

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WHEN CITIES PLAN INDUSTRIAL GROWTH

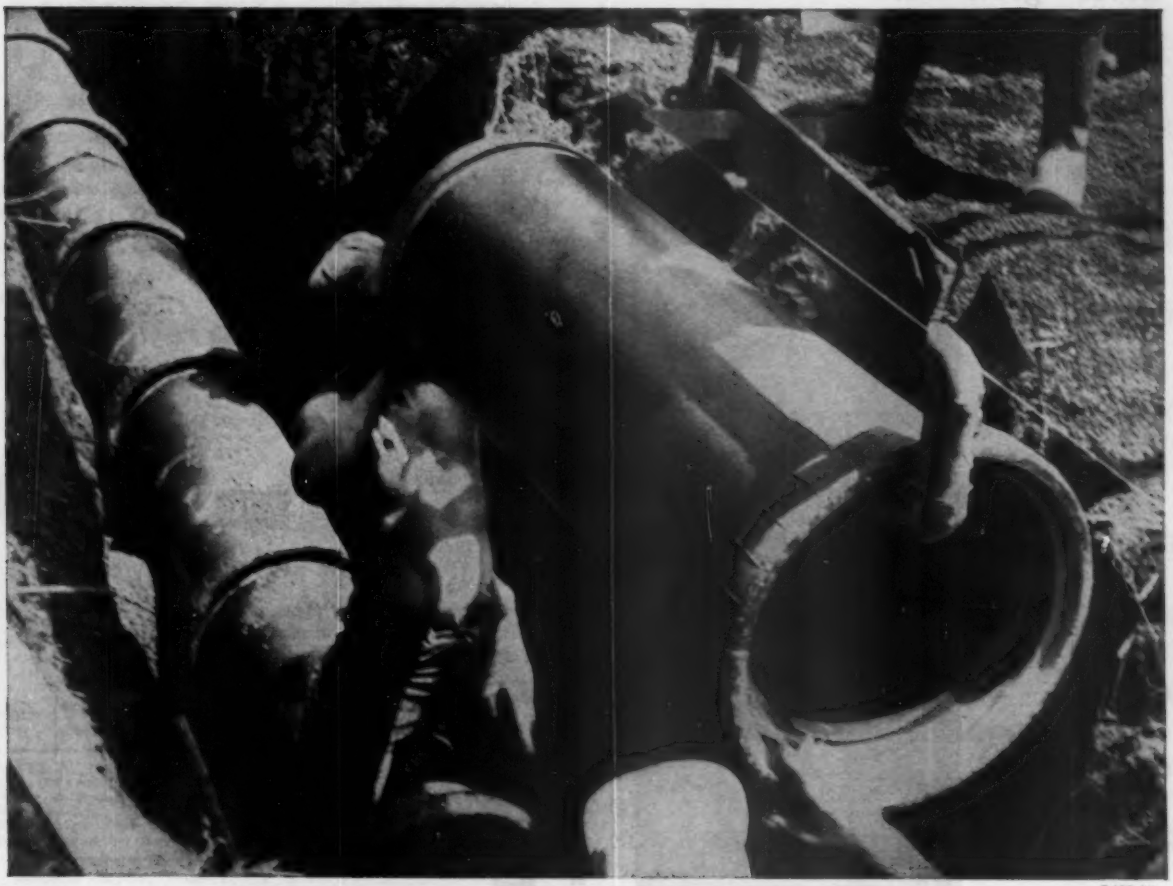
it pays to specify Vitrified Clay Pipe

SANTA PAULA, CALIFORNIA, already a bustling center of agricultural activity, is building to share in California's phenomenal industrial growth. To accommodate new industry and meet the needs of a growing population, Santa Paula recently completed a bond-financed sewer expansion project, using Vitrified Clay Pipe exclusively. Over 6 miles of Vitrified Clay Pipe were installed.

Like Santa Paula, growing communities everywhere need the permanence and safety that only Clay Pipe can provide. Clay Pipe is the only pipe that never wears out . . . does not rust, rot, corrode, or crumble. And with its new research-developed, factory-made joints, Clay Pipe is faster and easier to install than ever before.

When your community plans new sewerage facilities, be sure to consider the exceptional advantages of Clay Pipe. Its exclusive long-term guarantee is your assurance of permanent, maintenance-free service. Only Clay Pipe has *all* the features you can trust to handle industrial growth.

CITY OFFICIALS: James E. Leary, Mayor; Edwin C. Bixby, Ernest H. Oman, Ralph B. Crawford, Reece B. McCalister, Councilmen.
CONSULTING ENGINEERS: J. M. Montgomery Engineering Co. **CONTRACTOR:** N. P. Van Valkenburgh Co.



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If you choose to buy one of these chlorinators sight unseen, on our say-so, we can deliver immediately from warehouse stocks across the country. If not, your local F&P field office will be happy to demonstrate the 3400 Series at your plant, at your convenience. Call for an appointment. Or, write for complete information in Catalog 70C3400. Fischer & Porter Company, 200 Fischer Road, Warminster, Pa.

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Vol. 107 No. 10

OCTOBER • 1960

A Scranton Gillette Publication

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Editor and Publisher

FRED C. MAURER
Managing Editor

V. W. LANGWORTHY
Field Editor

C. F. GURNHAM
Consulting Editor

•

Contributing Editors

D. P. Backmeyer — R. E. McKinney
J. R. Baylis — R. C. Merz
P. D. Haney — A. M. Rawn
C. E. Keefer — R. W. Simpson
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CHICAGO OFFICE: 185 N. Wabash Av.

E. S. Gillette, Publisher
H. J. Conway, Adv. Ed.
F. C. Maurer, Managing Editor
V. W. Langworthy, Field Editor
W. W. Hamilton, Western Sales Mgr.
M. C. Barr, Circulation Mgr.
R. J. Rooney, Makeup Editor
E. J. Hoeffer, Asst. Editor
M. McGinnis, Edit. Secy.

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NEW YORK OFFICE: 155 East 44th St.

T. M. Todres, Administrative Assistant
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New Bulletins 100A

CLEVELAND DIGS SHALE AND ROCK 3-5 FT. DEEP FOR HIGHWAY DRAINAGE

THE JOB: 20 miles of drainage trenching in both inner and outer shoulders of five miles of dual highway for the relocation of U. S. Route 25 near Middletown, Ohio.

CONDITIONS: trench to be cut to grade, 18 inches wide, 3 or 5 feet deep depending on inner or outer shoulder, through very densely compacted shale and rocky material, further densified because much of the grade carried hauling equipment all through a winter, spring and summer.

PERFORMANCE: despite need to replace worn bucket teeth more frequently than usual because of the tough digging, a Cleveland J-40 dug the trench to accurate grade at the rate of 1,800 to 2,000 feet per 9 hour day.

J-40 FEATURES

- Stability—on wide-spaced crawlers, 1000-hour-lubricated
- 100% control of every operation at the operator's seat
- V conveyor for faster, higher, more efficient spoil discharge
- Pulley-enclosed dual, independent, conveyor drive
- Automatic conveyor shifting from side to side
- Over 30 non-slipping digging speeds
- Digs trench 17½ to 30 inches wide, down to 5½ feet deep.

WRITE TODAY for Bulletin L-110, a detailed report on the performance of the J-40 on this tough highway drainage job.

CLEVELAND TRENCHER

THE CLEVELAND TRENCHER CO., 20100 ST. CLAIR AVE., CLEVELAND 17, OHIO

Briefs

Pleasant Hills Sewage Plant—A vivid portrait of a 6 mgd sewage plant that is aptly described as a "garden spot in the midst of a park"—Page 369.

Water Desalting was one of the most comprehensively covered topics discussed at the 80th AWWA Conference both in regard to this new field's various methods of operation and its interesting if unpredictable future—Page 377.

Hogsmill Valley Sewage Works Start-up—This second part of the two-part series reports the methods used for starting the sludge disposal plant. The start-up was largely successful because gas was obtained two months after filling started and full operation of the dual fuel engines was possible within six months—Page 381.

Expansion of a Water Pumping Station in Australia reports on a station that will have a demand increase from 66 mgd to 95 mgd in five years. The equipment that will be used to meet this demand is described—Page 385.

Continuous Measurement of Oxygen to control and regulate aeration—On the basis of a study that compared various methods of continuous measurement, an apparatus was developed which operates electrochemically and permits the determination of oxygen in dirty water and in wastes—Page 388.

Ammonia Regeneration of Weak Base Anion Resin—This article is a formal discussion of a paper that reported the experience of operating a fifteen year old cation and anion exchange resin demineralizing plant producing as much as 1800 gpm of treated water for chemical process—Page 391.

A Stirring Event finds Partially Oriented rather *shook up* by the AWWA's recent Mixing of the Waters—Page 395.

Application of Gas Chromatography to Sludge Digestion Gas Analysis—A Research Progress Report on the status of gas chromatography as applied to sludge digestion gas analysis—Page 396.

Protection of Concrete Sewers from hydrogen sulfide—Although the proper design and operation is the primary precaution for eliminating sulfide in concrete sewers, other procedures, discussed in this article, may considerably reduce its attack on the pipes, even when some sulfide remains in the system—Page 400.

Treating Seasonal Sewage Flows—How a small town of 3,000 people met its needs for a sewerage system to serve a summertime population of 20,000 if the community was to continue to prosper as a vacation area—Page 404.

Baltimore County Sewage Pumping Station solved its odor control problem by using a year-around system developed after years of experimentation—Page 406.

Symposium on Waste Stabilization Lagoons provides a needed survey of what has been and what can be accomplished with this type of treatment process—Page 408.

News

Precipitation Gage for Corps of Engineers

Advanced Instrument Corporation (Advinco), Richmond, Calif., has delivered a pilot order of Hanes Telemetering Precipitation Gages to the U. S. Army Engineers, Waterways Experiment Station, Vicksburg, Mississippi. These instruments will be used in a large network for reporting rainfall and water levels throughout a watershed, enabling accurate reservoir control and flood prevention.

Under contract to the Corps of Engineers, Advinco perfected the basic design of Francis P. Hanes, Consultant to the Corps on Telemetering. The unit was required to be compatible with an existing telemetering system; also to be precise, reliable, rugged and low in cost.

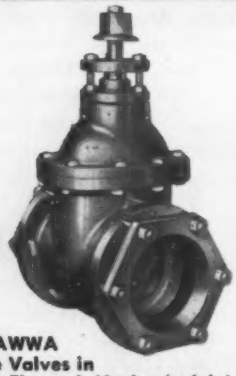
The Hanes Gage measures all forms of precipitation (liquid and solid), employing thermostatically-controlled snow and ice-melting heaters on collector ring and measuring vessel. In the latter, depth of water accumulated represents total precipitation. This is measured to the nearest 0.1 inch by an exclusive tape-driven probe coupled to a motor drive and water surface sensor. As the probe is raised from the bottom of the cylindrical measuring vessel, an electrical impulse is transmitted for each 0.1 inch of water. When the surface is reached, pulses stop and the probe automatically returns to rest; thus, the number of pulses telemetered represents precipitation in tenths of inches.

This pilot installation operates over a VHF radio link, but transmission is practically by low-grade wire line, telegraph and telephone and telephone circuits, or any type of radio facility. Information from many gages is presented at a central control station, whose operator can interrogate any gage at will. Readout is on a simple, inexpensive Veeder Root counter. Maximum gaging time is less than 20 seconds, even when using low cost, poor quality communication facilities.

IOWA

meets your most exacting specifications

FOR FLOW CONTROL: *in distribution and fire protection systems*



AWWA Gate Valves in Hub, Flanged, Mechanical Joint

to connect branch mains under pressure

Mechanical Joint Tapping Valves and Sleeves

to insert valves into existing line

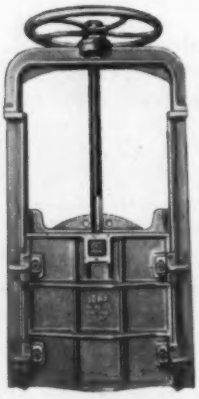
Mechanical Joint Cutting-in Valves and Sleeves

FOR FLOW CONTROL: *in sewage treatment and water filtration plants*

Flanged Gate Valves 2" through 42"

Flap Valves

Plug Drain Valves



Sluice Gates

Shear Gates

Check Valves

Square-Bottom Valves

Few manufacturers can match *Iowa* in offering such a wide variety of valves, accessories and specialties for water filtration and sewage treatment plants, as well as for water distribution systems. It will pay you to call in an *Iowa* man before placing your order!

IOWA VALVE COMPANY

Oskaloosa, Iowa • *A Subsidiary of James B. Clow & Sons, Inc.*

Since 1989 a reliable source for precision engineered products

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News—Here & There

Southern Gas and Water Elects Sylvester President

Albert L. Sylvester of Cohasset, Mass., has been elected president of the Southern Gas and Water Company, successor by change of name to West Virginia Water Service Company. The Company's two wholly-owned subsidiaries are the Southern Propane Company and the West Virginia Water Company.

The election of officers of the company was conducted at the annual meeting held recently in Charleston, W. Va. The West Virginia Water Company serves industrial, commercial and residential consumers in 17 West Virginia communities, including Charleston and the heavily industrialized Kanawha Valley.

North Dakota Ground Water Studies

Ground water studies have been authorized by the North Dakota State Water Conservation Commission in Burleigh County and the cities of Lankin and Walhalla to determine existing supplies of water.

The Burleigh County study will be made on a county-wide basis over a period of four years and will seek to find water supply for both agricultural and industrial uses. The Lankin and Walhalla surveys are to determine the amounts of water available for municipal use.

The Commission stated that its authorization was contingent on the financial participation by the interested parties.

Wisconsin Sewage Plant Supervisor Honored

John Wallendal, Supervisor of the Waupun, Wis., sewage treatment plant, was awarded the George F. Bernauer Memorial Award at the joint meeting of the Conference of Wisconsin Sewage Works Operators and the Central States Sewage and Industrial Wastes Association, held June 16, in Madison.

The Award, first to be presented in Wisconsin, is given "For Exceptional Contribution In The Field of Waste Water Technology" as indicated by the operational records of successful plant performance; and/or the successful solution of important or complicated operational problems; and/or outstanding contributions in wastewater technology as related to problems in the State of Wisconsin.

Mr Wallendal's award was cited as an example of good operation of sewage treatment facilities in the interest of public health and the protection of stream cleanliness.

Plastic Sewer Pipe Gains F.H.A. Construction Approval

Plastic sewer and drain pipe, produced under a new Commercial Standard, now meet the requirements of the Federal Housing Administration and is suitable for use on FHA-insured construction. Although plastic pipe for residential construction has been considered by FHA for several years, plastic sewer pipe is the first to meet FHA requirements.

The conditions under which plastic sewer pipe may be used are described in FHA Use of Materials Bulletin, UM-26.

Negotiations with FHA for the Society of the Plastics Industry (SPI) were handled by Bert S. Montell, secretary of the SPI Thermo-plastic Pipe Division, and Walter S. Prendergast, chairman of the SPI Committee on Sewer Drain and Conduit Products.

The specific applications designated in the FHA bulletin covers solid plastic sewer pipe for house sewer connections and storm drain lines, as well as perforated pipe for foundation footing drains and septic tank absorption fields.

The specification covering plastic sewer pipe is detailed in the commercial Standard, CS 228-60. An important change in the specification, however, is that the crushing strength to meet FHA requirements has been raised from the 800 pounds per linear foot in the Standard to 1,000 pounds per linear foot.

All solid plastic pipe used on FHA construction must be marked as follows: Name of manufacturer; Diameter; "Sewer Pipe, CS 228-60, Minimum Crush 1,000# ft."

Engineers Complete Storm Drain Report

An engineering report on the control of surface storm water in the Orcutt area of Santa Barbara County has recently been completed by the Engineering Service Corp., Los Angeles, Calif.

The sudden growth of the Orcutt area resulting from the development of Vandenburg Air Force Base created a potential flood menace which, it was feared, would become increasingly acute with continued population growth. Therefore, the engineering firm was engaged by the Santa Barbara Flood Control and Water Conservation District in March to prepare a comprehensive and orderly program for planning construction of flood control facilities.

The proposed plan established and locates a system of five drainage channels and underground conduits for the disposal of all storm water from all parts of the Orcutt area. The drainage plan as proposed will provide flood protection which will facilitate the orderly development of the area for the future.

Polyvinyl Chloride Pipe Standard Issued

A new edition of the Commercial Standard for PVC pipe, designated Rigid Unplasticized Polyvinyl Chloride Pipe, CS 207-60, has recently been made available by the Commodity Standards Division, Office of Technical Services, Business and Defense Services Administration, U. S. Department of Commerce.

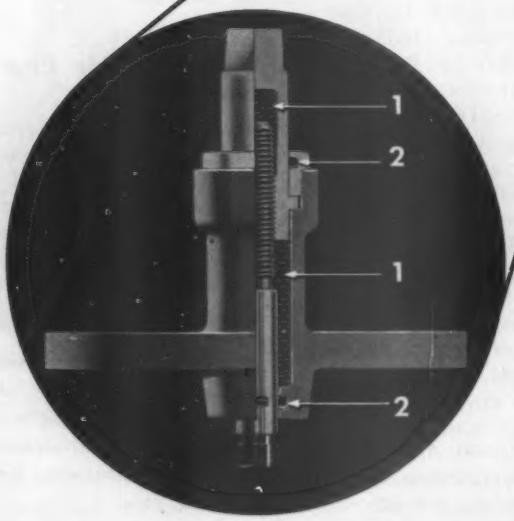
The revised standard provides requirements and methods of test for materials, dimensions, workmanship, chemical resistance, brittleness and minimum burst pressure for two types of PVC pipe.

The revision had been proposed by the Society of the Plastics Industry, Inc., and has been endorsed by a representative cross-section of the industry. Copies may be purchased from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., price 10c each.

WHAT'S INSIDE?

A BIG PLUS

AUTOMATIC LUBRICATION AND DOUBLE "O" RING SEALS



Smith Fire Hydrants are easy to operate, inexpensive to maintain and most dependable in meeting severe climate and operating conditions. In addition to maximum flow and simplicity of design, Smith Hydrants now have two additional features of major importance: (1) Automatic lubrication — chamber sealed with "O" Rings contains a permanent type lubricant—temperature range −30° to 200°F. Each time the hydrant is operated, the threads and bearing surfaces are automatically lubricated. (2) "O" Ring Seals — the lower "O" Ring seals the internal pressure, the upper "O" Ring is a combined external dirt and moisture seal. This construction eliminates the conventional stuffing box and packing gland adjustments. These and other well-known Smith superior design features assure positive operation, minimum maintenance and long service life.

64

FIRE HYDRANTS · VALVES · SINCE 1896

THE A.P. SMITH MFG. CO.

EAST ORANGE . NEW JERSEY

Twelve P.F.T. Floating Covers with P.F.T.—Pearth Gas Recirculation on 110' Digesters at Cincinnati's new Mill Creek Sewage Treatment Plant.

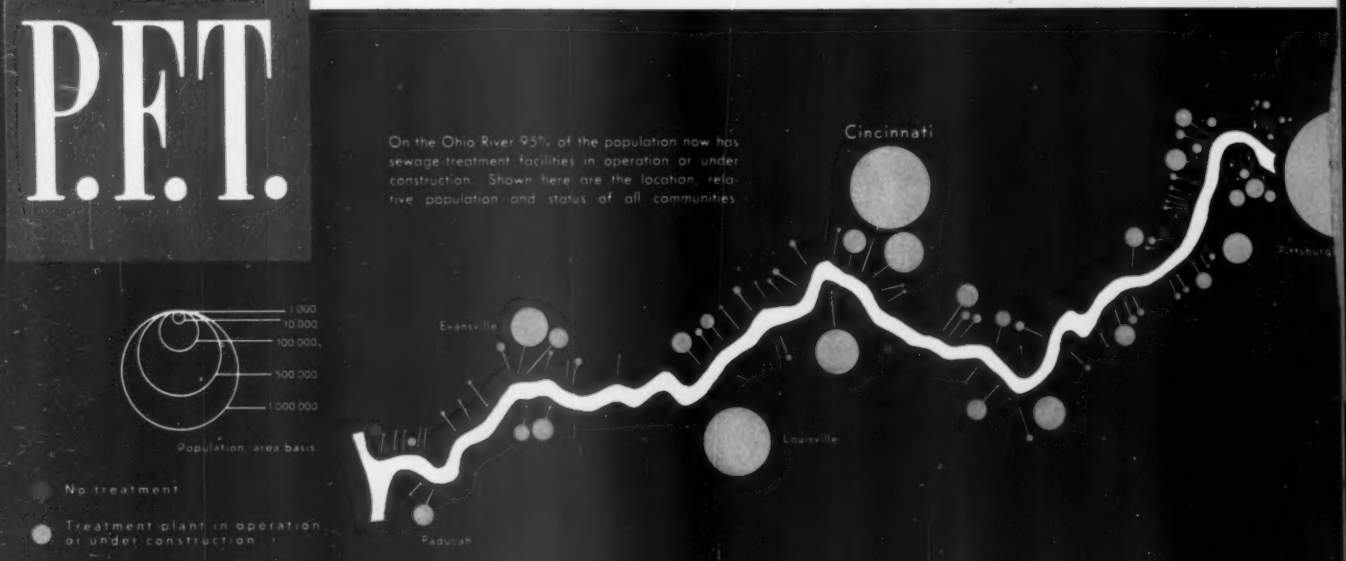
Cincinnati Continues Leadership in Ohio River Clean-Up Program

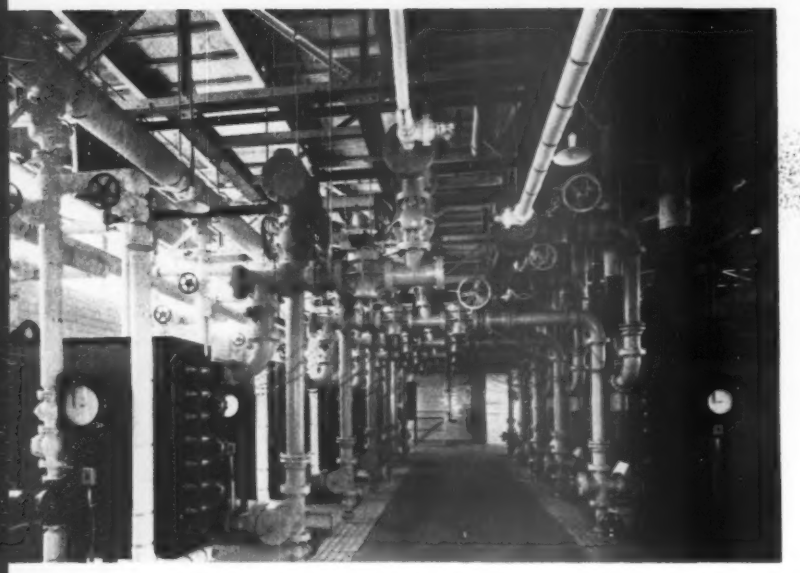
Exalted in song and legend for its beauty, the Ohio River is being restored through the pledged efforts of eight states to keep the river free of pollution.

Leading this crusade under the program of the Ohio River Valley Sanitation Commission (ORSANCO) the city of Cincinnati has constructed three plants: Little Miami, Muddy Creek and Mill Creek. Largest of the plants is the modern Mill Creek plant. This facility with a design flow of 120 mgd is the heart of greater Cincinnati's program which handles not only all wastes from Cincinnati but 26 suburbs and some 2,000 industries.

P.F.T. Digester equipment matches the other facilities at this plant which are blended to make this America's most functionally beautiful and modern plant. Many "firsts" including newly developed laboratory analytical equipment for rapid checks of industrial wastes and closed circuit television giving visual checks of operation of various plant units ensure the most effective treatment. With this plant now in service, Cincinnati is truly leading the way to a renewed beautiful Ohio.

P.F.T.





Battery of P.F.T. Heat Exchangers and Heater Units.

Entire project including innovations in plant control under the direction of Arthur D. Caster, Sewage Disposal Engineer

Cincinnati's entire sewage treatment program was designed by the consulting engineering firm of Havens and Emerson

Depicted on the above map are the locations of sewage treatment plants safeguarding the Ohio River. P.F.T. is proud to have a major part in this vital program with equipment at a large number of these plants.

Cincinnati's Mill Creek plant, ORSANCO'S leader, embodies "leadership equipment" designed and manufactured by P.F.T.

Here at this modern plant are twelve P.F.T. Floating Covers on 110′ digesters with P.F.T. aluminum metal clad insulated roofing. Six of these controlled digesters are equipped with P.F.T.—Pearth Gas Recirculation units with the balance arranged for future Pearth installation.

Shown in the photo at the left is Cincinnati's "Hall of Heaters" with four P.F.T. 1300S Shell and Tube Heat Exchangers, two P.F.T. 1000 and five P.F.T. 1500 Heaters and Heat Exchangers. Also located adjacent to the digesters are twelve additional P.F.T. 500 Shell and Tube Heat Exchangers.

These 23 P.F.T. Heat Exchanger units are integrated to form an effective, flexible heating system ensuring accurate temperature control for the 12 digesters. P.F.T. Gas Safety Equipment ensures safe utilization of sewage gas produced.

waste treatment equipment exclusively since 1893

PACIFIC FLUSH TANK CO. 4241 RAVENSWOOD AVENUE, CHICAGO 13, ILLINOIS

PORT CHESTER, N.Y. • SAN MATEO, CALIF. • CHARLOTTE, N.C. • JACKSONVILLE • DENVER

Meetings

1960

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Oct. 2-6—Philadelphia, Pa. (*Hotel Sheraton*) Thirty-Third Annual Meeting WATER POLLUTION CONTROL FEDERATION

Oct. 2-9—Montivideo, Uruguay (*Hotel Carrasco*) INTERAMERICAN ASSN. OF SANITARY ENGINEERING. Write: J. G. Stewart, Room 2008, 165 Broadway, New York 6, N. Y.

Oct. 5-7—Bismark, North Dakota (*Grand Pacific Hotel*) NORTH DAK. SECTION WATER POLLUTION CONTROL FEDERATION

Oct. 6—Hamden, Conn. (*Sanford Barn*) CONN. SECTION A.W.W.A. Sec., Donald W. Loiselle, Supt. of Supply, Bridgeport Hydraulic Co., Bridgeport, Conn.

Oct. 6-7—Salt Lake City, Utah (*Newhouse Hotel*) INTERMOUNTAIN SECTION A.W.W.A. Secy., M. R. Snell, Supt., Power & Light Dept., Soda Springs, Idaho.

Oct. 9-12—Birmingham, Ala. (*Tutwiler Hotel*) ALA-MISS. SECTION A.W.W.A. Secy., Ernest Bryan, McWane Cast Iron Pipe Co., Box 2601, Birmingham. Ala.

Oct. 9-13—Boston, Mass. AMERICAN SOCIETY CIVIL ENGINEERS

Oct. 16-19—Galveston, Tex. (*Galvez Hotel*) SOUTHWEST SECTION A.W.W.A. Secy., Leslie A. Jackson, Mgr.-Engr., Municipal Water Works, Robinson Memorial Auditorium, Little Rock, Ark.

Oct. 19-21—Des Moines, Iowa (*Fort Des Moines Hotel*) IOWA SECTION A.W.W.A. Secy., J. J. Hail, Supt., Water Dept., City Hall, Dubuque, Iowa.

Oct. 20-22—Walla Walla, Wash. (*Marcus Whitman Hotel*) PACIFIC NORTHWEST POLLUTION CONTROL ASSOCIATION G. H. Dunstan, Secy., Box 176, Pullman, Wash.

Oct. 20-22—Atlantic City, New Jersey (*Madison Hotel*) NEW JERSEY SECTION A.W.W.A. Secy., A. F. Pleibel, Dist. Sales Mgr., R. D. Wood Co., 683 Prospect St., Maplewood

CONTINUED ON PAGE 88A

We know we can help you with Coagulation, Softening, Iron and Manganese removal, Corrosive Water and Filtration. We have years of experience in this field, and our FERRI-FLOC (Ferric Iron Sulfate) does an outstanding job in producing purer process water. And, of course, we offer reliable technical assistance—Let us tell you about it.

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Washington Viewpoint

Probably the most significant thing Congress did, as it finally quit work for the year, was to approve the full amount of $50 million for Federal grants to aid stream pollution control. If you look at the final appropriation bill for the Department of Health Education & Welfare, you'll find a bit of legalistic trickery involved in this: Congress actually approved (and the President signed) $45 million for pollution works—but it directed HEW to apportion this money on the basis of $50 million. That means that HEW can come back to Congress next winter to get the extra $5 million if needed.

This sort of "now you see it, now you don't" finance is a favorite device in Washington, so that the bill finally presented to the taxpayer won't seem too big, or, occasionally, in a Congressional attempt to force economies on a department or agency. Congress did something similar in the $40 million appropriations bill for the military department: It told the departments they could have the money, then directed them to spend only 96½ per cent of it on procurement.

Anyway, the President's signature on the HEW appropriations (which, combined with the Labor Department money, was nearly a half-billion over budget requests) doesn't mean all the money will be spent. The President has the right to direct the departments to hold back their spending. But, in an election year, chances are good that there'll be no holdback of funds for a while.

☆ ☆ ☆ ☆

Other than the appropriations bills, however, the record of this Congress—insofar as the construction industry and sanitary specialists may be concerned—is one of negatives: What Congress didn't do is far more important than what it did. For instance, Labor got absolutely nothing—attempts to raise the minimum wage floor and to legalize "situs" picketing failed. Nothing was done about taxation by states of out-of-state business; nothing was done about a proposal for Federal licensing for civil engineers; the Health Educational Facilities Construction Act never got out of committee; a proposed expansion of the saline water program didn't see any action; attempts to get tax relief for the self-employed (through exemptions for self-financed retirement plans) failed.

Want more? Water pollution control amendments, aimed at strengthening HEW's hand in this area went under; so did proposals for air pollution control changes and proposals for project grants for public health training, and a scheme for establishment of an "institute" under the aegis of the Tennessee Valley Authority to train foreign engineers and officials in water control and development. And there were many others.

☆ ☆ ☆ ☆

That meeting of the Federal Water Pollution Control Advisory Board in San Francisco (early in September) is a prelude to action on pollution problems that have long been a sore spot in San Francisco Bay. There's a major problem, though: Among principal offenders are a number of Federal installations which have been dumping raw sewage into the water. Trouble is, Congress has several times recognized the problem, but refused to appropriate money to alleviate it.

☆ ☆ ☆ ☆

Almost a tenth of all city capital-outlay expenditures went for sanitation projects, according to Census bureau reports for the year 1959. The total, to be exact, was $1.3 billion--compared to $1.7 billion for education and $1.5 billion for streets and highways.

☆ ☆ ☆ ☆

Two of the four new divisions in the Bureau of State Services of the Public Health Service are of direct concern to sanitary engineers. Established as a part of a service-wide reorganization program, designed to strengthen environmental health programs, they are: Division of Air Pollution, headed by Vernon G. MacKenzie, a career engineer officer of PHS; and Division of Occupational Health, headed by Dr. Harold J. Magnuson.

☆ ☆ ☆ ☆

Although it didn't get anywhere before Congress closed up shop, it is interesting that Senator Hubert Humphrey revived the long-standing idea of a Federal department of science and technology in a bill submitted near the end of the session. You may recall that similar proposals were beaten down last year by the almost unanimous opposition of most government departments and many technical societies on the grounds that such a department would further complicate an already complex area and might inhibit technological growth rather than aid it. Humphrey's proposal is a little more inoccuous: It calls for appointment of a study commission to decide if such a department would be feasible and useful. There's little doubt the measure will come up again next time around.

☆ ☆ ☆ ☆

The House action in finding officials of the Port of New York Authority in contempt for refusing to cooperate with an investigative committee can have serious repercussions in the field of sanitation and water supply. In fact, so worried are officers of some of the interstate compact groups that a bill introduced on the last day of the session (HR 13269) which would have specifically protected the New England interstate water pollution control compact from such Congressional interference.

Crux of the Congressional action was insistence that, since Congress must approve interstate compacts of all kinds and specifically reserves the right to alter and amend terms of such compacts, it also has the right to investigate their operations. Port of New York Authority officials, supported by Governors of New York and New Jersey, contended that no investigative right exists since this "would constitute a novel intrusion of the Federal goverrment into the areas reserved...to the states, and would constitute a precedent which could subject various agencies of the state governments throughout the nation to be answerable to Federal authority..." The House would have none of that argument, however and voted to cite PNYA officials for contempt of Congress.

This action, then, prompted Rep. Lawrence Curtis, of Massachusetts, to introduce his bill concerning the New England compact. Under terms of this measure, the section of the law relating to Congress' right to alter and amend interstate compacts would be altered to read: "The right to alter, amend or repeal this act is expressly reserved, except that nothing....shall be construed to confer on the United States any right to investigate or regulate any act performed under this compact..." Of course, the bill died with the adjournment of Congress, but you can be sure this issue will be revived next year.

☆ ☆ ☆ ☆

Evidence that Congress is far from through with proposals for diverting water from the Great Lakes, is contained in a letter sent recently to the Chief of Engineers by Wisconsin's Senator Alexander Wiley. In the note, Wiley urges the Corps to include in its 1962 fiscal year budget (due in January) "recommendations for a study of Great Lakes Water Levels". The Corps undertook such a study in 1952, but it was not completed.

On the Great Lakes matter, as you know, the Supreme Court may rule on Chicago's plan for diversion of added water this winter; and the Senate's Foreign Relations Committee is also scheduled to take up the matter after the new Congress convenes.

SAFER, MORE EFFECTIVE MUNICIPAL SEWAGE TREATMENT

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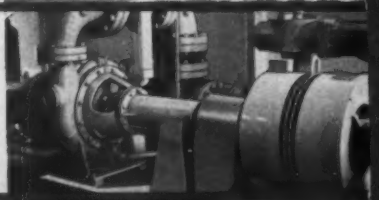
SP-5 Pumps for High Head, Heavy Duty Raw Sewage Pumping



OTHER CHICAGO PUMP EQUIPMENT AT PLEASANT HILLS

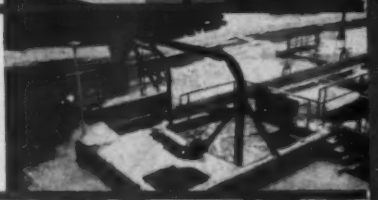
Chicago Comminutors

Non Clog Sewage Pumps

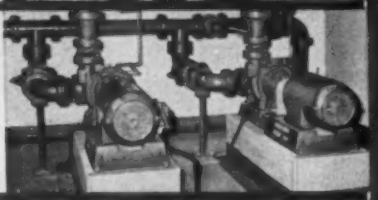
Utility Water Pumps

Precision Diffuser Tubes

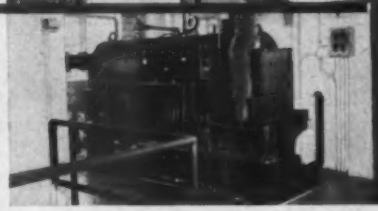
Aer-Degritter Grit Removal System for Controlled Washing, Transporting and Concentrating Grit



Scru-Peller Pumps for Clog-Proof Primary Sludge Pumping



Chicago-Cyclotherm Sludge Heat Exchanger and Digester Heater



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Equipment News

Large Diameter Bituminized Fibre Pipe

1001

Construction Products, Division of Sonoco Products Company, Hartsville, S. C., has developed a new kind of pitch-impregnated fibre pipe which is available in larger diameters than other fibre pipe previously being marketed. It is called P.I. Pipe and features laminated spiral construction, an exclusive feature.

Designed for use in all types of low-pressure installations, P.I. Pipe is produced in sizes ranging from 4" inside diameter to 36" inside diameter. It is recommended for gravity flow lines where the maximum head does not exceed twenty feet.

Strong, highly corrosion resistant, and economical, P.I. Pipe is particularly suited for use in industrial waste treatment and disposal systems. In addition, its size and properties make it suitable for highway drainage, for venting fumes and gases, for sanitary sewers and storm drains, and for forming round concrete columns in excessively moist sites.

Each order of P.I. Pipe is custom-made to meet the demands of its intended use. Specifically, wall thickness of the pipe can be varied in any given diameter, to meet crushing strength requirements of the particular job.

New Floating Digester Pontoon Cover

1002

Chicago Pump Company, Chicago, Ill., has announced a line of new Digester Pontoon Covers that have been completely redesigned and engineered to incorporate the latest standards of structural design and to provide the highest live load safety factor.

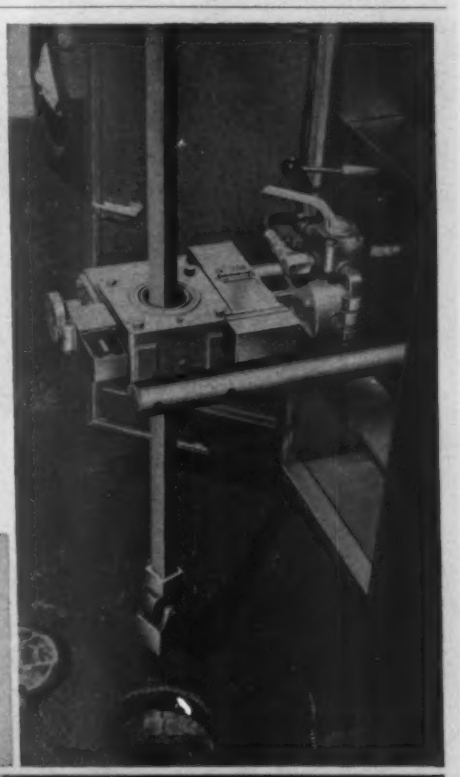
This new cover also features reduced field erection time and cost; ballasting for operating gas pressures of 12 inches of water; purlines and top truss chords punches to permit nailing or bolting of rafters; parts marked for placement according to into place by cranes.

The covers also feature positive pontoon action. The pontoon portion of the cover ceiling plate is always immersed in liquid, not in gas, and thereby prevents tipping.

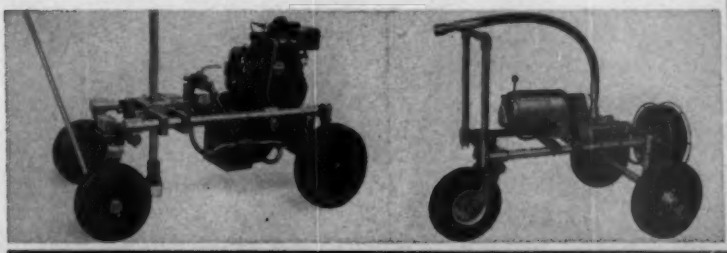
Chicago Digester Pontoon Covers are now available with variable purlin locations to accommodate precast concrete roofing slabs. The use of concrete assures longer roof life; provides additional weight to increase gas pressures; and eliminates the need for ballasting in many cases.

CONTINUED ON PAGE 19A

HYDRAULIC TRUCK MOUNTED VALVE OPERATORS PROVIDE ONE MAN CONTROL OF VALVES FROM 10" TO 60" SHIPPED FULLY ASSEMBLED, FOR MOUNTING IN ANY MAKE OF TRUCK BY YOUR OWN MECHANICS, WITHIN A FEW HOURS. HAS SAFETY DEVICE FOR DAMAGE PROTECTION ALSO POSITION INDICATOR.



PORTABLE 3-10 HP. ELECTRIC DRIVE



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Read-o-Matic*
the only
self-powered meter-register
you can read outdoors
All Badger models can be equipped with the Read-o-Matic, for economical meter reading at conveniently located stations.

From Badger's "meter-ology" specialists...

a complete line of disc, turbine, compound and propeller meters for any high-accuracy job

For over 55 years, Badger has concentrated its research, design, development and production on meters. This "meter-ology" specialization has brought about many of the most important advances in the field.

Badger disc meters, for example, feature the exclusive dovetail thrust roller insert as standard equipment. This insert cuts wear and noise at the water level, and guarantees more accurate registration.

Our propeller meters, too, offer a major design advantage: they can be mounted even in an inclined position without affecting meter accuracy.

Still big news is the revolutionary Read-o-Matic outdoor meter-register — a completely new product that further proves Badger's "meter-ology" leadership.

Your Badger representative — a "meter-ology" specialist himself — will give you complete details on our whole line of meters, including the popular models shown here. Ask him to call on you soon.

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for setting meters
in confined locations...

USE MUELLER® ANGLE METER STOPS COUPLINGS

■ Two fittings; a Mueller Angle Meter Stop and Angle Meter Coupling, are the only fittings required to complete a meter setting in a tight location.

With the new combined O-ring seal — ground key seal design in all Mueller Meter Stops you are assured of a positive, double seal against leakage which might result from piping stresses on the stop body.

A complete range of sizes is available with either copper coupling or iron pipe threads.

Write for complete information and specifications.

MUELLER CO.
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Factories at: Decatur, Chattanooga, Los Angeles
In Canada: Mueller, Limited; Sarnia, Ontario

Equipment News

CONTINUED FROM PAGE 15A

Diffuser With Self-Cleaning Non-Clog Teeth

1003

The American Well Works, Aurora, Illinois, has developed a new American "Aircomb" Diffuser with self-cleaning non-clog teeth.

Teeth on both sides of the "Aircomb" provide simple, multiple, variable-flow orifices for controlled aeration. No "blurps" at low air flows. Unique peaked-dome design prevents accumulation of solids. Velocities are self-cleaning. Variable diffusion capacity is as high as 5:1 if necessary. There is nothing to break or need replacement or change.

The American "Aircomb" is fully proved in the field and is unconditionally guaranteed for five years. It has very useful application in preaeration, channel diffusion, and activated sludge installations. It is especially preferred where relatively high tank content agitation is required and where other types of diffusers present operating difficulties due to clogging.

It is also an ideal diffuser for recarbonation, since carbon dioxide will go into solution readily. No maintenance is required.

Electric Chlorinator

1004

Clayton Mark & Company, Evanston, Ill., has developed an electrically operated, positive feed chlorinating unit, designed for use in farm, home, and commercial water well systems, as well as swimming pools.

Engineered to treat up to 75,000 gallons of water daily, the new Clayton Mark Electraclor duplicates at minimum cost the expensive water purification services of metropolitan communities.

A newly designed cast aluminum case, finished in white and gold, makes the unit harmonious in appearance with other modern automatic appliances.

The Electraclor is controlled by the same electrical circuit that operates the water pump in a private well system. It is in action only when water is being pumped into the water storage tank to maintain the desired pressure.

In operation, the new electric chlorinating unit injects a tiny stream of ordinary liquid household chlorine bleach into the water supply in the exact proportion needed to safeguard health. The unit's rate of feed can be adjusted by a finger tip control knob, used to set the strength of the chlorine solution in the tap water within the ratio range prescribed by state health departments.

High Speed Modular Electronic Data Accumulator

1005

Data Instruments, Division of Telecomputing Corporation, North Hollywood, California, have an-

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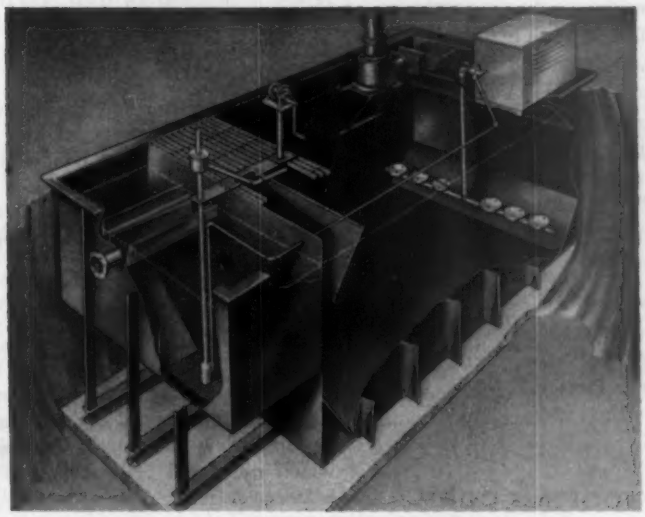
INTRODUCING SCHMIEG INDUSTRIES

"CENTRI-SWIRL"



COMPLETE PACKAGED AERATION TYPE SEWAGE TREATMENT PLANT

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AVAILABLE IN VARIOUS CAPACITIES

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Equipment News

CONTINUED FROM PAGE 19A

nounced the availability of a new, speed data accumulator and recording system employing a modular concept that has the capability of accepting as many as six independent data inputs through the addition of individual accumulator units.

The Telecordex Model 180 is a multiple input recording and indicating data accumulator which records and stores sequential measurement pulses. Bidirectional input pulses at rates to 15,000 per second can be accepted from measurement devices that generate sequential pulses as a function of the parameter being measured. Each channel has a maximum storage of plus or minus 999,-999 counts.

The output of the system can be recorded by an electric typewriter at 600 characters per minute, by IBM Keypunch or Summary Punch at 50 cards per minute, or by a tape perforator. The new system represents design refinement over previous models and incorporates more than ten years of engineering and operating experience.

Automatic Engine Controls

1006

Synchro-Start Products, Inc., Skokie, Ill., has designed a new Automatic Control especially for underpass and pipe line pumping.

This is a program timer control for use on gas, gasoline or diesel engines. It is encased in a steel, weather proof enclosure. The control includes one of their standard auto-

matic engine controls together with a timer driven by a governed D. C. motor. All current is taken from the engine battery so that no commercial power is required for their operation. Many variations are available, including safety protection for all abnormal conditions.

When an engine is equipped with Synchro-Start controls, it can be "Present" for the length of time, time of day or night, and the days of the week the engine is required to run, as well as the time it is to be stopped.

Controllers Available in Bellows-Type Models

1007

Bristol Company, Waterbury, Conn., has announced the production of their new pneumatic controllers which use metal bellows in the unbalance detector. These metal, bellows-type controllers are recommended for batch-type processes with frequent startups, and for installa-

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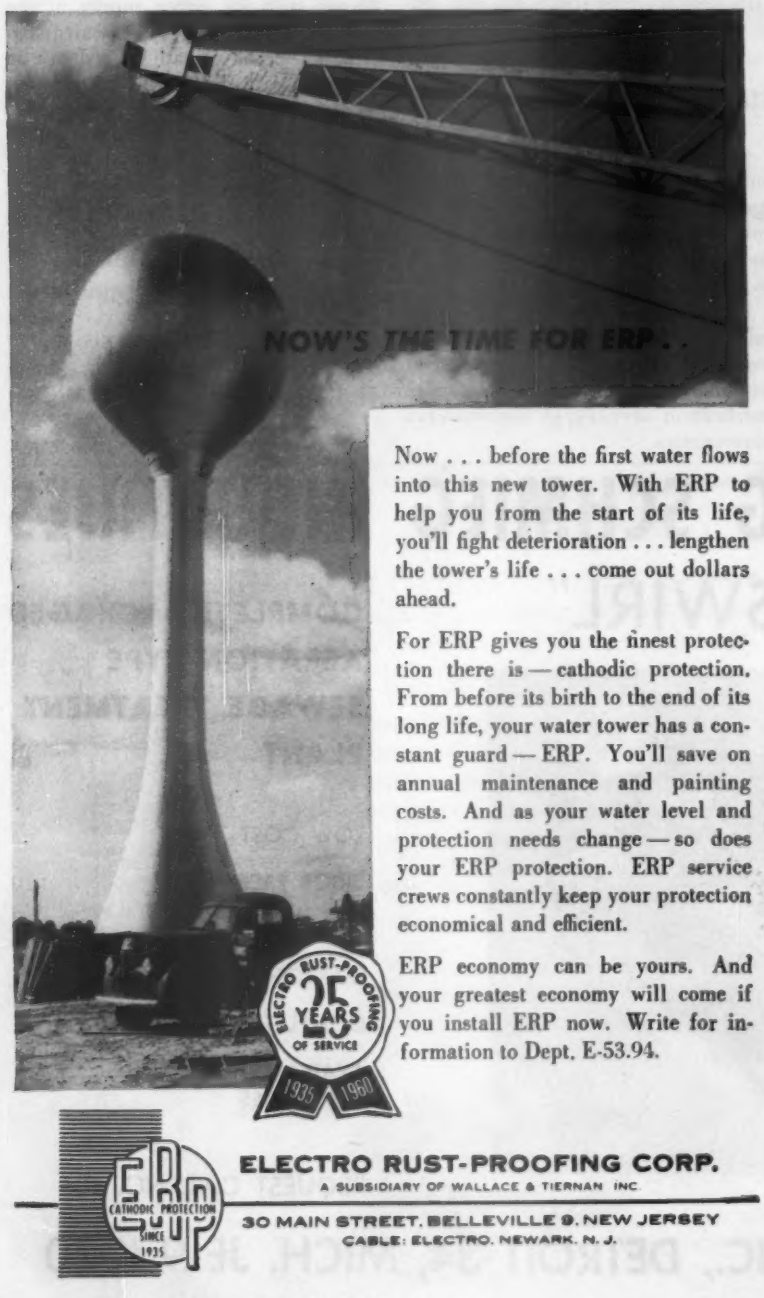

Now . . . before the first water flows into this new tower. With ERP to help you from the start of its life, you'll fight deterioration . . . lengthen the tower's life . . . come out dollars ahead.

For ERP gives you the finest protection there is — cathodic protection. From before its birth to the end of its long life, your water tower has a constant guard — ERP. You'll save on annual maintenance and painting costs. And as your water level and protection needs change — so does your ERP protection. ERP service crews constantly keep your protection economical and efficient.

ERP economy can be yours. And your greatest economy will come if you install ERP now. Write for information to Dept. E-53.94.

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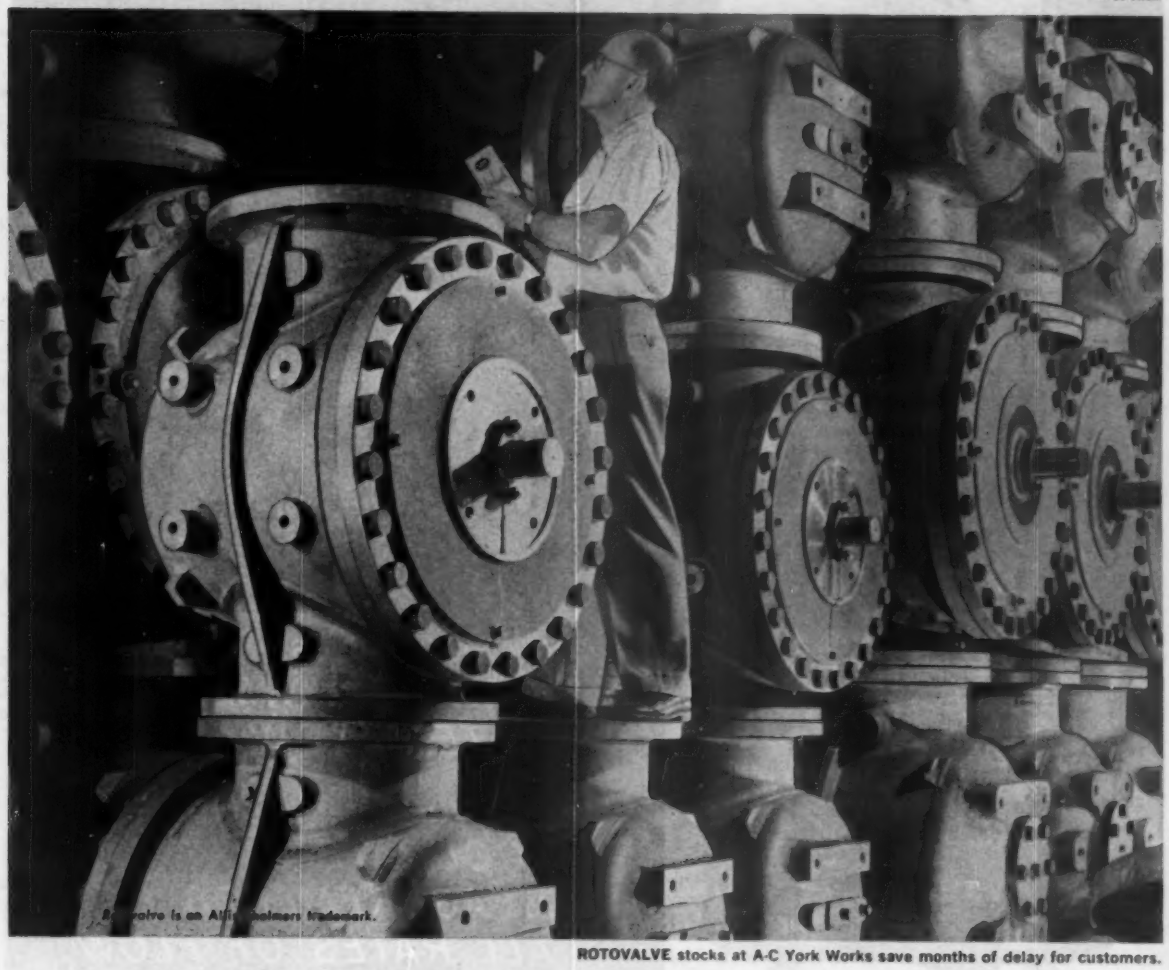
ALLIS-CHALMERS

A-1260



ROTOVALVE stocks at A-C York Works save months of delay for customers.

Another Allis-Chalmers time-saving exclusive:

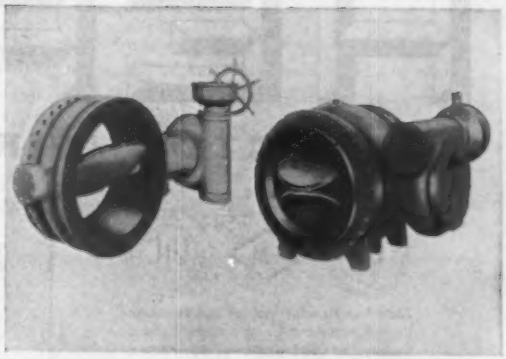
Cone valves "right off the shelf!"

Six to thirty-inch *Rotovalve* units — awaiting your call. Think of the valuable time you save! Typical is the case of a western municipality that recently needed one 24-inch and three 20-inch *Rotovalve* units for their waterworks. Allis-Chalmers assembled all accessories required, completed testing and shipped the valves to customer in less than three weeks! Compare this with the 3 to 6 months normally required by other suppliers for delivery.

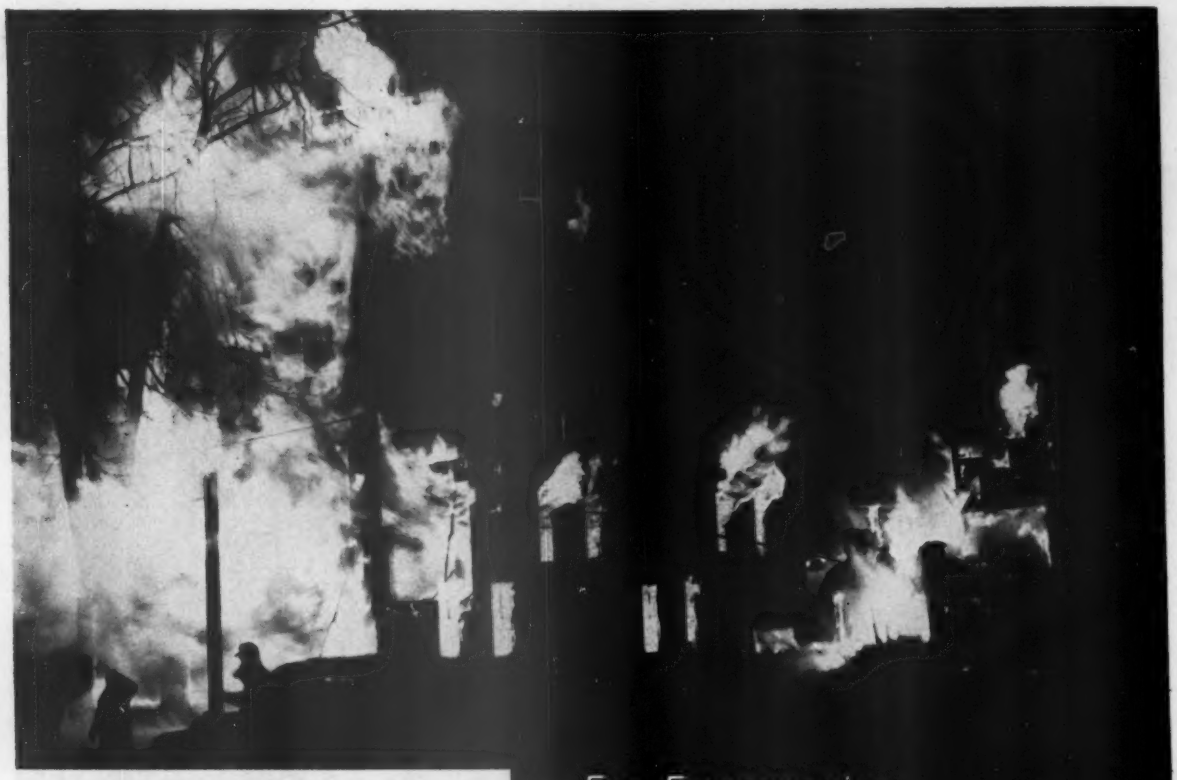
Perpetual off-the-shelf inventory of *Rotovalve* units, butterfly and ball valves gives Allis-Chalmers today's only complete rotary valve-stocking program... guarantees fastest deliveries to you.

Avoid troublesome, costly delays and get the valves you need to do the job right. For immediate assistance anytime, call your nearby A-C valve representative, district office or write **Allis-Chalmers,** Hydraulic Division, York, Pa.

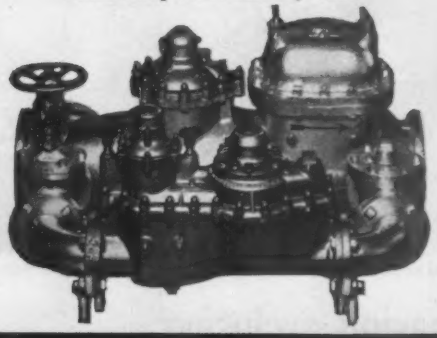
Rotovalve is an Allis-Chalmers trademark.



Standard butterfly and ball valves illustrated are also available from stock in a broad range of sizes.



Hersey Detector Meter Model FM
with Compound Meter By-Pass



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ACCURATE MEASUREMENTS OF ALL RATES OF FLOW

You get both with a

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DETECTOR (FIRE SERVICE) METER

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Equipment News

CONTINUED FROM PAGE 20A

tions where ambient temperature is variable.

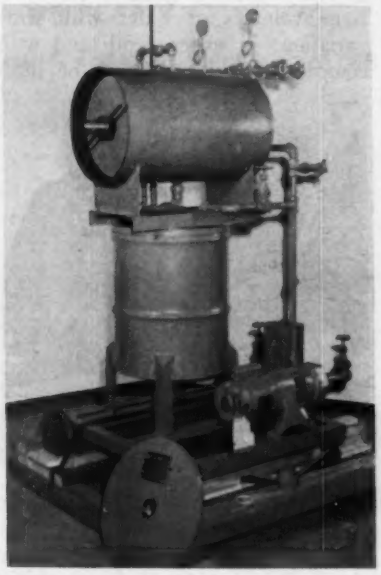
Lower minimum gain, reduced drift and hystersis effects, lower temperature effects, and increased sensitivity are some of the features of the new controller. Other characteristics are similar to the company's diapharagm-type Metagraphic controllers.

The bellows-type models are offered with integral or remote setpoint for the following control modes: on-off, adjustable proportional, proportional plus reset, fixed proportional plus reset, and proportional plus reset, plus derivation control.

Experimental Filters

1008

Hercules Filter Corporation, Hawthorne, New Jersey, has just developed a small pressure leaf filter of simplified design. This experimental



filter is available in capacities ranging from ten to thirty square feet. It consists of a flat-ended tank with a fixed center discharge pipe on which the leaves are placed. One bolt fastens the lid; it is, therefore, easy to open and close.

CONTINUED ON PAGE 24A

Back at the turn of the century it didn't matter much what size you were... capacity counted most. Of course the days of the big schuper and free lunch have disappeared from the American scene. However, another type of "joint"—this one tailor-made for ***all sizes*** of vitrified clay pipe, has been gaining in popularity by leaps and bounds. It's KAUL Presto-SEAL, with precision-dimensioned, factory-molded polyester spigots and sockets that ***joint like magic.*** This revolutionary development reduces shear load action to the minimum and permits a tight, equalized compression throughout the full circumference of the pipe. It's **EASY** to assemble without special tools. It's **FLEXIBLE,** regardless of temperature... will absorb all line movement. It's **PERMANENT**... leak-proof, root-proof, corrosive-resistant... provides trouble-free service forever. It's **ECONOMICAL**... less trench space is needed; no tedious joint pouring is required; extensive inspections are eliminated; saves costly labor and materials on every installation.

And—Presto-SEAL is *not* an experimental process of limited availability in but a few sizes of pipe. In fact, thousands of miles of Presto-SEAL, in sizes from 4" to 36", both standard and extra strength, are providing large savings in both pumping and treatment plant costs everywhere. Approvals from public works officials, engineers and contractors are evidence of the preference-acceptance of Presto-SEAL clay pipe by KAUL.

Write today for complete particulars. Then, specify Presto-SEAL pipe for your next job!

*T.M. Reg.

KAUL clay company

TORONTO, OHIO• U.S.A.

"Exclusive manufacturer of Presto-SEAL pipe that joins like magic"

Equipment News

CONTINUED FROM PAGE 23A

The ten square footer has a shell length of twelve inches. Complete with filter and full complement of five leaves, including crating, this model is available in steel and #304 stainless steel (tank and leaves).

The thirty square footer has a shell length of twenty-seven inches. Complete with tank, full complement of fifteen leaves, including crating, this model is available in steel and Stainless Steel (tank and leaves).

Panelboards are Equipped with Magnetic Starters

1009

General Electric Co., Plainville, Conn., has available a new line of distribution panelboards with enclosed magnetic starters. This new equipment is rated 600 volts A.C. maximum. Magnetic starters are used in NEMA siezs #0 through #3, with 50-horsepower rating maximum.

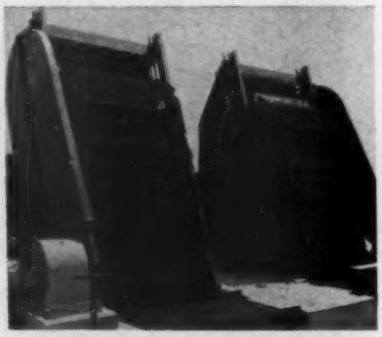
The starters are mounted in twin unit construction and are arranged for panelboard mounting directly below the disconnect devices. The starter line terminals are wired to either the circuit breaker or fusible switch. Each starter is individually compartmentized and equipped with removal cover. In addition, each starter cover has an external reset and latch and provisions for padlocking.

This new line of motor starter panelboards is designed to replace hodgepodge wall-mounted installations of separate devices at no increase in cost and, frequently, at a lower total installed cost. All components of this new type of panelboard are listed with Underwriters' Laboratories, Inc.

Traveling Water Screen

1010

The Jeffrey Manufacturing Co., Columbus, Ohio, has announced the availability of a traveling water screen for removing leaves, twigs, grass, seaweed, kelp, fish, needle ice and similar solids from surface waters being reclaimed and prepared for further use. It can be designed for handling large volumes of water with wide variations in water depth and with comparatively low loss of head



through the screen when screening medium is clean.

The Jeffrey Screen, usually installed in vertical position in the intake structure, consists of moving panels or baskets covered with suitable wire mesh attached to two strands of 24" pitch Steel Thimble Roller chain. It may run continuously or intermittently depending on plant requirements and amy be furnished with manual, time or differential level control.

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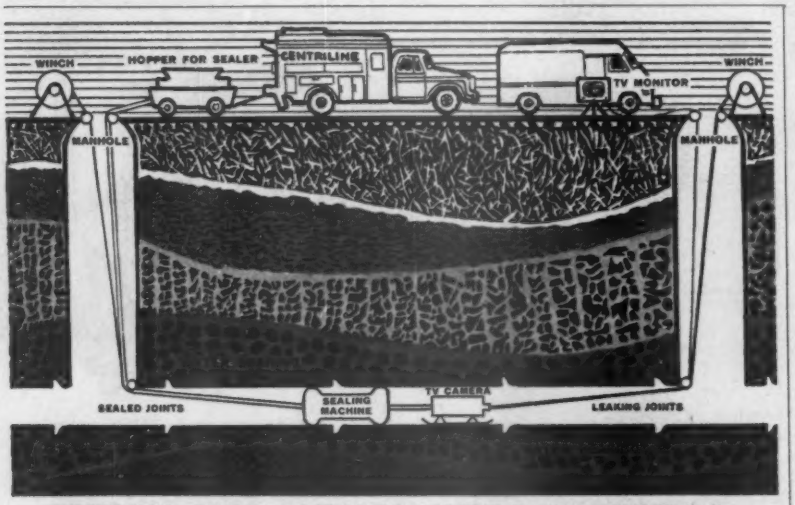

NEW! THE CENTRISEAL PROCESS ELIMINATES LEAKING JOINTS

Now joint leakage can effectively be stopped in small as well as large sanitary and storm drains. By remote control—constantly monitored by television which finds the leaks and checks the seal afterwards—special CENTRISEAL PROCESS equipment forces a fast-setting polymeric sealer into open joints **from the inside.** This forms a tough seal in the pipe joint as well as outside in the surrounding soil. You're thus assured a permanent bond, and leakage from either internal or external pressures is prevented. No excavations are necessary and the grouting process is remotely controlled from above ground. Savings are found in maintenance and pumping costs and capital expenditures are avoided.

INCIDENTALLY... If your problem is more than leaking joints, if you have deteriorated pipes, investigate the other Centriline services. The CENTRILINE PROCESS lines pipes with a cement mortar or acid-resistant epoxy mortar applied centrifugally. Because the pipes remain in place, there's no traffic interruption. Pipe life is increased, ground and pavement settlement due to infiltration eliminated. Write now for complete information on the CENTRISEAL PROCESS for leaking joints and the CENTRILINE PROCESS for lining pipe.

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Subsidiary of Raymond International Inc.

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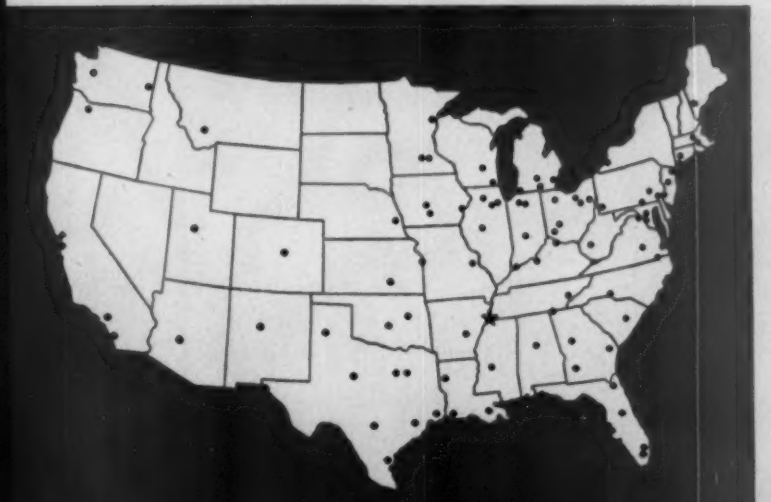
Any service is only as good as its availability when you need it.

Layne service for *any* pumps, wells, water systems and water treatment for Industry—Municipalities—Agriculture is available throughout the world, 24 hours a day. The vast network of Layne Associate Companies with over 75 years' experience, trained personnel and quality Layne replacement parts, assure prompt and complete service wherever you may be located. Industrial Sales Representatives in major cities. Write for Layne Service Bulletin 100.

Layne complete water services include: initial surveys • explorations • recommendations • site selection • foundation and soil sampling • well drilling • well casing and screen • pump design, manufacture and installation • construction of water systems • maintenance and service • chemical treatment of water wells • water treatment • all backed by Layne Research.



Layne SINCE 1882 — WORLD'S LARGEST WATER DEVELOPERS

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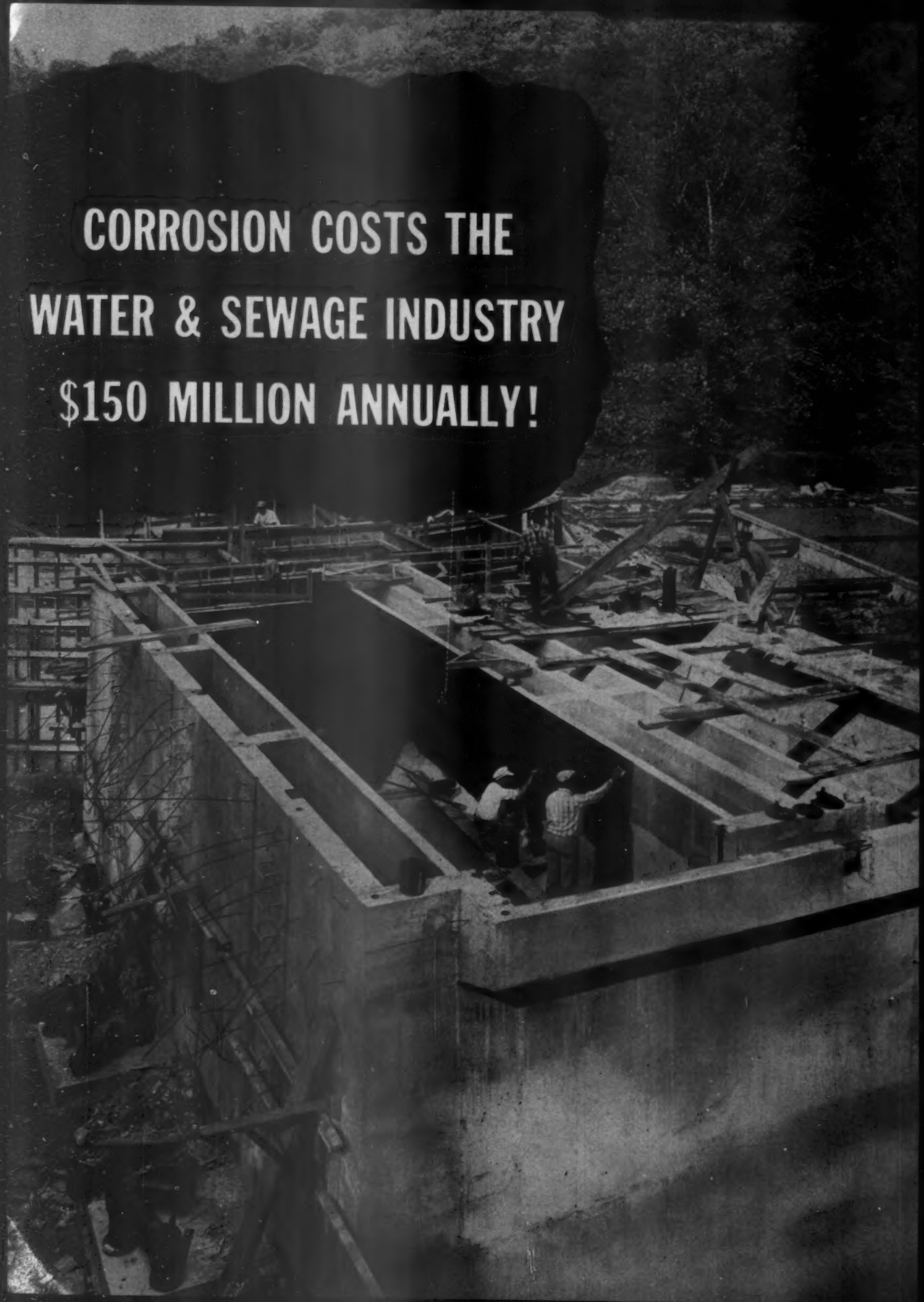

CORROSION COSTS THE
WATER & SEWAGE INDUSTRY
$150 MILLION ANNUALLY!

Now You Can Control 96% of All Your Water & Sewage Corrosion Problems with this Proven PITT CHEM® Coating System!

Construction of water and sewage handling equipment costs almost twice as much today as it did 10 short years ago. That's why it's more important than ever to effectively protect your investment against corrosion—a "cost" factor that takes a $150 million toll in the water and sewage industry each year.

Water and sewage equipment is subject to a wide variety of corrosion conditions, some of which are the most severe in industry. More and more water and sewage maintenance engineers are turning to the complete PITT CHEM System of cold-applied coatings for long-lasting protection against corrosion. From ordinary moisture conditions to extreme chemical corrosion in digester tanks, PITT CHEM provides a coating tailored to stop corrosion and reduce your maintenance costs.

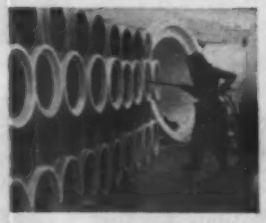
PITT CHEM Tarset, Tarmastic and Insul-Mastic are tough, *heavy* film coatings that outlast conventional maintenance paints 10 to 20 times. You measure their protection in *decades*, not years. They can be cold-applied by brush, spray gun or roller. No other family of protective coatings can solve so *many* of your corrosion problems so *economically*.

For more information, mail the coupon below. Then consult your nearest PITT CHEM Distributor—he's listed in the "Yellow Pages." Or call Pittsburgh Coke & Chemical Company in Pittsburgh, New York, Chicago, Houston or Los Angeles. A PITT CHEM Corrosion Engineer will be glad to discuss your corrosion problems.

PITT CHEM TARSET®

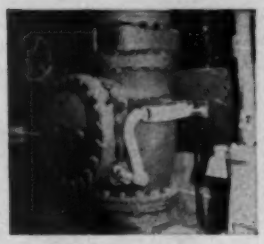
The original, patented coal tar-epoxy coating, Tarset is designed to control severest water and sewage corrosion. Widely used for protection of digester tanks, sludge vessels, filtering systems, and pipes carrying acid and alkaline waters. Specify Tarset for your toughest corrosion problems.

PITT CHEM TARMASTIC®



A broad family of coal tar coatings formulated to meet a wide variety of corrosive conditions at moderate cost. Concrete settling basins, steel structures, masonry foundations and tank bottoms are just a few of the many proven applications of PITT CHEM Tarmastic coatings.

PITT CHEM INSUL-MASTIC®



Vapor and moisture penetration problems can be effectively and economically solved with Insul-Mastic Gilsonite-asphalt coatings. Especially recommended as a durable weather and moisture barrier on metal, concrete and masonry surfaces. Insul-Mastic insulating cork mastics provide excellent condensation control.

PITT CHEM PIPELINE ENAMELS

PITT CHEM A.W.W.A. Plasticized Enamel conforms to American Water Works Association specification C203-57 and is widely used for external coating of potable water pipes and internal lining of potable water piping and storage tanks. Other Pitt Chem Pipeline Enamels are extensively employed by the gas and oil industries.

Send for Your Free Copy of this

WATER & SEWAGE CORROSION DATA FILE

Includes a survey of corrosion problems in the Water & Sewage Industry, data on PITT CHEM Coating Systems and a coating selector guide.

Name_____ Title_____

Company_____

Street_____

City_____ State_____

PROTECTIVE COATINGS DIVISION

PITTSBURGH CHEMICAL CO.

GRANT BUILDING PITTSBURGH 19, PA

A Subsidiary of PITTSBURGH COKE & CHEMICAL CO.

866

PIPE THAT DOESN'T GET COLD FEET IN WET TRENCHES

This cast iron pipe was installed to carry water to an important industrial site in Indiana.

At the time of installation, weather conditions were severe; the trenches were wet and muddy.

Still, the cast iron pipe was easily and speedily assembled, enabling the contractor to complete the job well ahead of the deadline.

Cast iron pipe does not get cold feet over rugged soil conditions. Its rugged design, corrosion-resistant qualities, and bottle-tight joints will withstand the most severe conditions.

Modern, cement-lined cast iron pipe will deliver a continued full flow of water for at least a century . . . and rarely requires repairs or replacement.

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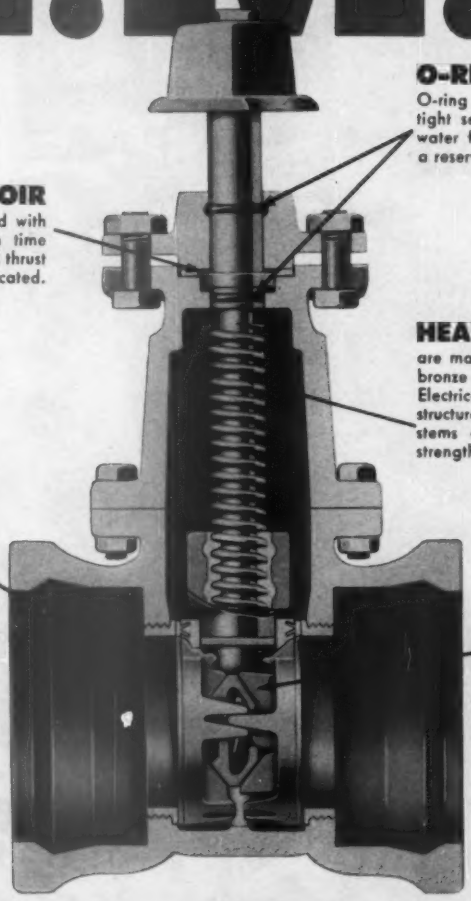
CAST IRON PIPE
THE MARK OF THE 100-YEAR PIPE

M.M. gate valves...



O-RING STEM SEALS
O-ring at bottom provides a positive water-tight seal. Upper O-ring seals dirt and water from bearing surfaces and acts as a reserve pressure seal.

LUBRICANT RESERVOIR
the area between the O-rings is filled with a special, life-time lubricant. Each time the valve is operated, both O-rings and thrust collar are completely lubricated.

HEAVY BRONZE STEMS
are machined from high tensile strength solid bronze rod for all valves up to 16". Electrically upset thrust collar improves grain structure. Valves 18" and larger have stems cast from extremely high tensile strength manganese bronze.

BRONZE DISC RINGS
are dovetailed to become part of the disc and are then machined for precise mating with the seat rings.

FOUR POINT WEDGING MECHANISM
exerts even pressure at four points near the outer edge of each disc to eliminate disc deflection and distortion and to assure tight shut-offs.

by

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MINIMUM MAINTENANCE...

The great attention to every detail in research, design and engineering that is a part of every Mueller product, assures you years of maintenance-free service from gate valves by Mueller. Your water supply or fire protection system is always dependable when Mueller gate valves are an integral part of the system. All of these valves contain the long life features of Double Disc, Parallel Seat type construction specifically designed for water distribution piping. Mueller Iron Body, Bronze Mounted Gate Valves are another example of the quality products made for the water industry. Complies with AWWA specifications. For complete information, write . . .

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Equipment News

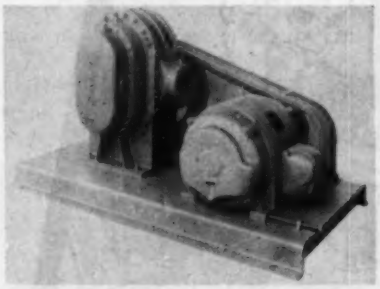
CONTINUED FROM PAGE 24A

Clean intake water, free of debris and objectionable solids, is essential for all uses of large volumes of water. Screens have been sold to municipalities, steel companies, coal companies, paper mills, oil companies, atomic energy plants, electric generating stations, the Army and Navy, and the U. S. Post Office.

Packaged Blower Units

1011

Sutorbilt Corp., Compton, Calif., has introduced a new compact packaged blower unit, shipped completely assembled and ready for installation. It comprises a Sutorbilt blower mounted on a common base with drive, and both single and double stage units are available. For special applications, a sanitary base can be supplied.



Suitable for use wherever an air supply does not currently exist, or where there is a need to increase air supply, the new unit is available in capacities from 1500 cfm at 3 psi to 450 cfm at 10 psi covering a horsepower range from ½ to 40.

The Sutorbilt blower itself is a positive pressure rotary blower, manufactured with wide face herringbone gears and specially-designed timing hub to further simplify field adjustment. The wide face herringbone timing gears hold rotating impellers in alignment, minimize lateral thrust under load, maintain impeller clearances and eliminate head plate contact.

These blowers act on the principle of positive displacement of air or gas by Figure "8" impellers which rotate in opposing directions to deliver a metered volume for each revolution. They are used for sewage disposal, water distillation, flotation, aeration, ventilation, pneumatic conveying, forced draft of combustion air, and inert gas pressurizing systems.

Fail-Safe Control For Pressure Tanks

1012

Healy-Ruff Company, St. Paul, Minn., has developed a new, "fail-safe" control for hydro-pneumatic pressure tanks designed to eliminate any danger of the tank becoming over charged with air because of a quick drop in water level or on failure of the float to operate.

The new control circuit shuts off the pumps on either a high-water level or a high pressure. A high-flux ceramic magnet and magnetic linkages are used between the float and the limit switch. Both air pressure and water level in the tank are regulated automatically. Correct air-to-water ratio is maintained by automatically operating the pumps to add water and

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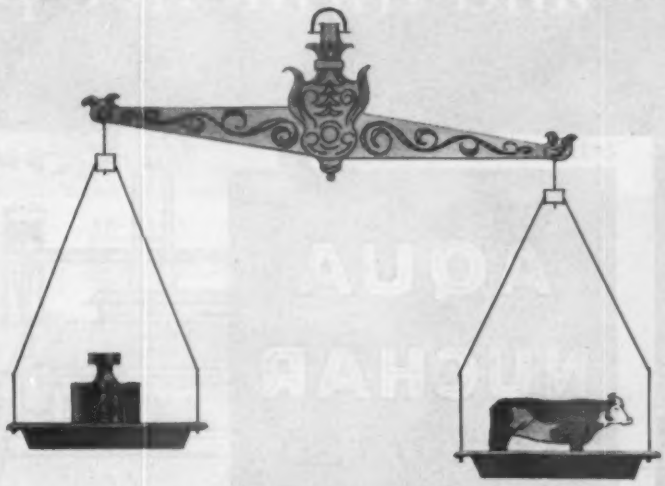


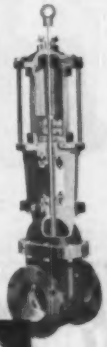
For Value Received

Should price be the sole measure of the value of any product? In almost any business—whether it's "ships, shoes or sealing wax"—you can find some one who will reduce its quality if you require him to reduce its price.

British philosopher John Ruskin once said: "There is hardly anything in the world that someone cannot make a little worse and sell a little cheaper—and the people who consider price alone are this man's lawful prey.'

Much credit for the rapid growth of M & H belongs to customer-good-will, customer-confidence, and an extraordinarily healthful customer relationship. Due to a combination of fair dealing, improved product-design, quality materials, delivery schedule-integrity, and honest prices, M & H customers over the years have developed a sense of loyalty to the Company. They simply like to do business with M & H because a basic principle of the Company's sales policy is that the price paid for an M & H product is only one factor of the value the customer receives.

Practical, efficient, dependable field service of M & H products goes on year after year—long after the price is forgotten. No wonder that M & H business volume has grown and grown, and inevitable leadership in the industry has come to the Company and its products.



(No. 5 of a Series)

M&H VALVE AND FITTINGS COMPANY
ANNISTON, ALABAMA
SUBSIDIARY OF WALWORTH

how to *keep* friends and influence people!

You can contribute importantly to building community good will, to attracting new people, new building, new industry, vacationers...all that adds to local prosperity!

You do it by serving water that is *consistently palatable* . . . completely in keeping with the American standard of living today.

You do it by daily threshold odor tests to detect trouble instantly. You know precisely the amount of AQUA NUCHAR needed from day to day to adsorb all taste-and-odor-forming substances. And you thereby save your town money.

When unusual problems arise, you can rely on our authoritative technical service. We're glad to be part of your plan to *keep* friends and influence people.

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Equipment News

CONTINUED FROM PAGE 31A

the air circuit to add or release air as necessary.

Other features include: springless mechanism for pressure sensing, heavy-duty load relays, complete color coded wiring, independent start settings for each pump and field adjustment of both level and pressure without changing the control mounting.

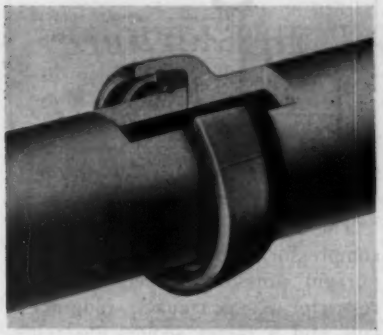
Clay Pipe with Factory-Made Joints

1013

Robinson Clay Product Co., Akron, Ohio, has developed and introduced its Wedge-Lock clay pipe, a new snap-together, factory-made, plastisol joint designed to eliminate the joint as a source of contamination and to provide an easier way of jointing.

Cast on the spigot end of Wedge-Lock pipe is a solid, smoothly curved ring of plastisol. A mating ring of the same material is cast inside the bell.

The new joint is designed on the double-ball principle for easy and rapid installation. When the joint is made, it reaches and holds maximum



compression, resulting in a tight line, which prevents infiltration, exfiltration and the penetration of roots.

In addition to meeting ASTM and Federal Clay Pipe Speecifications, Wedge-Lock meets or exceeds all requirements of ASTM Specification C 425-58T, for vitrified clay pipe using materials having resilient properties.

Transistor Pipe Detector

1014

Computer Measurements Company, Sylmar, California, has announced production of its new transistor pipe detector, the Detectron Model 808 which incorporates circuitry specifically designed to utilize transistors to their fullest advantages.

Inadequacies usually inherent in transistors, such as heat limitations, have been eliminated by the use of special compensating circuitry. Thus, the 808 is suitable for use in hot Southern climates where the heat instability of transistors has previously been a problem.

In the many applications of a pipe detector, the principal feature of the 808, in contrast to tube instruments, is in the tracing of pipes and cables by the conductive method. This is of a particular advantage in areas where highly mineralized soil is the problem, or where there are many abandoned pipe lines.

Easily Removable Filter

1015

Micro Metallic Division of Pall Corp., Glen Cove, N. Y., have incorporated a special, straight-through

CONTINUED ON PAGE 34A

PACIFIC
A TYPE FOR EVERY SERVICE
RUGGED — DEPENDABLE
NON-CLOG
SEWAGE PUMPS

DRY PIT - WET PIT
SUBMERSIBLE
HORIZONTAL
CHOICE OF IMPELLERS

NON-CLOG DRY PIT pump with double suction elbow and stand. Send for Bulletin 1850.5.

NON-CLOG WET PIT with cover. Single unit. Duplex models with alternating controls available. Send for Bulletin 1850.2.

PACIFIC NON-CLOG PUMP with motor, motor support bracket, suction elbow and stand. Send for Bulletin 1850.5.

HORIZONTAL NON-CLOG MODEL with flexible coupling. Send for Bulletin 1850.5.

SUBMERSIBLE NON-CLOG
A complete unit ready to install includes pump, motor, automatic controls and cable to control panel. Send for Bulletin 1850.5.

Outstanding performance and long trouble-free service from every type. Pacific Non-Clog Sewage Pumps combine all desirable design features that assure efficient, economical and dependable operation and service.

Order now. ALL TYPES AVAILABLE FOR IMMEDIATE SHIPMENT.

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Manufacturers and Distributors of Pumps for Every Service
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Equipment News

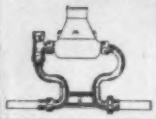
CONTINUED FROM PAGE 33A

design into its new filter housing so that the bowl can be removed from a pipe without disturbing the pipe connections. The container design permits fabrication in a wide variety of materials with maximum cleaning ease and accessibility to all fluid passageways.

The housing is generally furnished in type 304 stainless steel, or, on special order, in an alloy to match the porous stainless steel standard elements. Corners are rounded, where possible, both inside and outside. A quick-opening closure makes removal of the bowl and replacement of the element a matter of seconds. Housings can be designed to withstand up to 10,000 psi; 125 or 300 psig is standard.

Elements can be supplied of porous metal for use with or without a filter aid, as cylinders, bayonets, stars or in special types such as Rigimesh® corrugated sintered woven wire mesh. Filtration ratings of elements range from 2 to 55 microns nominal (98%) with absolute ratings as low as 15 microns available with certain types of elements.

Why it is PROFITABLE to use FORD products

Meter men know their settings		**1. You Standardize Your Settings** Regardless of the model, Ford yokes and setters provide standard, permanently aligned settings. No time lost trying to "rassle" around with the odd ones.
	Keep your meters on the level	**2. You Set Meters Horizontally** No matter how the water line runs—horizontally, vertically, in a corner or diagonally, Ford settings keep your meters level for most efficient operation.
Change a meter in a few moments		**3. You save on Meter Changes** Meters set in Ford yokes or setters may be removed and replaced quickly and economically. The time saved on one meter change may more than pay for the setting.
	50 years or more in one place	**4. Inside or Outside - Settings are Permanent** Whether you have basement or outside meters Ford settings are good for the life of the service.
Do you use shallow settings?		**5. Adaptations for Every Climate** Ford shows you how to get the best settings for your climate—and provides all the equipment, even to meter boxes, barrels, forms and covers.
	Be sure you are paid enough	**6. Complete Testing Equipment** Ford bench or portable testing equipment helps you keep meters operating efficiently so that you get paid for all the water you deliver.
You get the breaks on new inventions		**7. Ford Research Keeps You Out in Front** For over 60 years Ford has specialized in developing and producing better equipment for setting and testing water meters. Stay "out in front" with Ford.

FOR BETTER WATER SERVICES

FORD

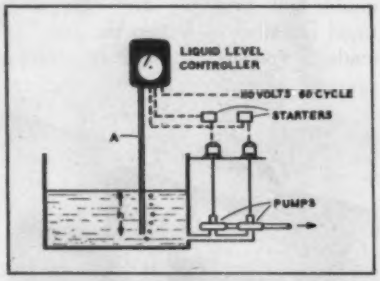
THE FORD METER BOX COMPANY, INC.
WABASH, INDIANA

Level Control Packaged in Single Unit

1016

Foxboro Co., Foxboro, Mass., is now offering a "packaged" control unit for use in water and sewage treatment plants. The unit combines the familiar bubble tube method of measuring level and the reliability of Rotax electrical control.

Features of the instrument: ±0.5 per cent accuracy; ranges from 0-10 inches of water up to 0-10 feet of water; no cleaning or servicing problems; simple to install, even in inaccessible locations such as reservoirs and underground tanks.



The new controller consists of a compressor, a purge rotameter, diaphragm pressure element, damping restrictor, Rotax contacts, plug-in relays and a pump sequencing relay. It can be furnished as an indicator, a recorder, or—where long distance transmission is required—as a telemeter transmitter. All components are housed in a single instrument case, to which a bubble tube is connected.

Portable Pipe Repair Kit

1017

Dresser Manufacturing Division, Bradford, Pa., is offering a portable repair kit, designed for simple, economic, and rapid permanent repairs to pipe and tubing, pipe joints, pipe fittings, and tanks and other vessels.

Designated as the "Util-Seal", this new epoxy resin utility repair

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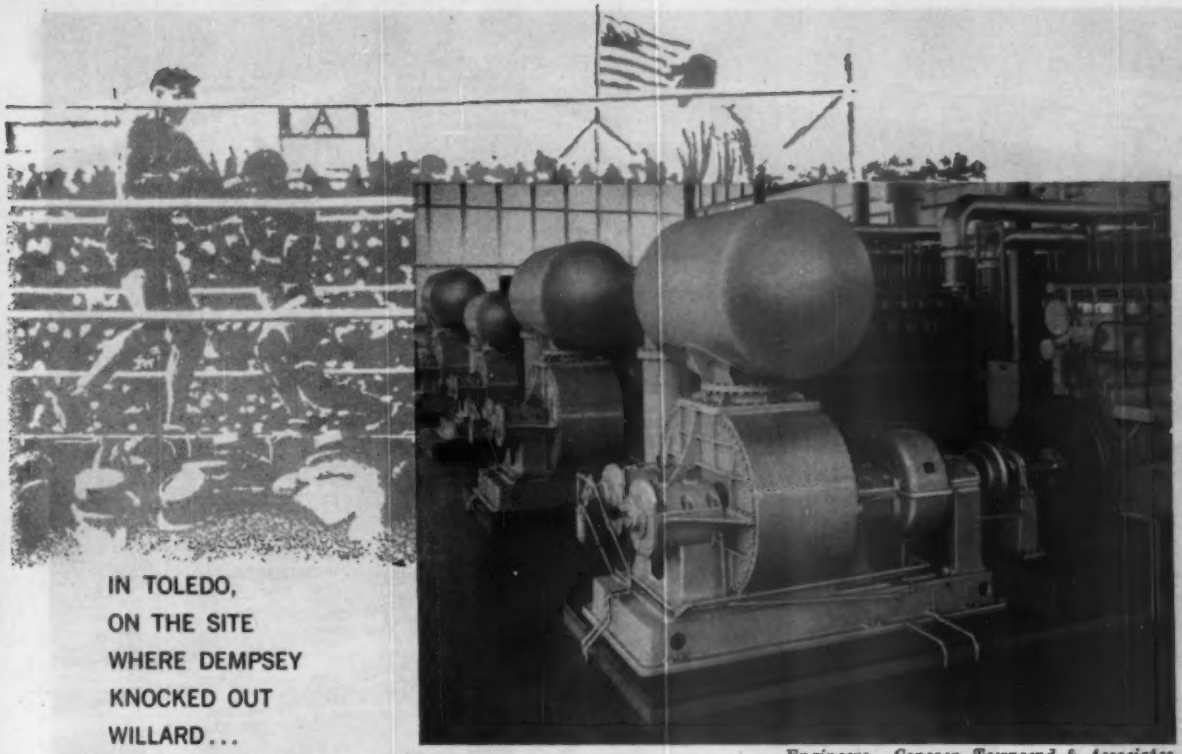


IN TOLEDO,
ON THE SITE
WHERE DEMPSEY
KNOCKED OUT
WILLARD...

Engineers—Consoer-Townsend & Associates

ROOTS AERATION BLOWERS

PROVIDE THE "KNOCK-OUT" IN SEWAGE TREATMENT

Roots-Connersville equipment in the heart of the outstanding Toledo installation includes four large rotary blowers driven by Enterprise tri-fuel diesel engines and one Electric Machinery synchronous motor-driven blower. The Roots blowers supply a total of 80,000 cfm of air at 4 to 8 psi. Infinite control of the volume of air delivered to the aeration tanks is achieved through the use of multiple units which can also be operated at variable speeds.

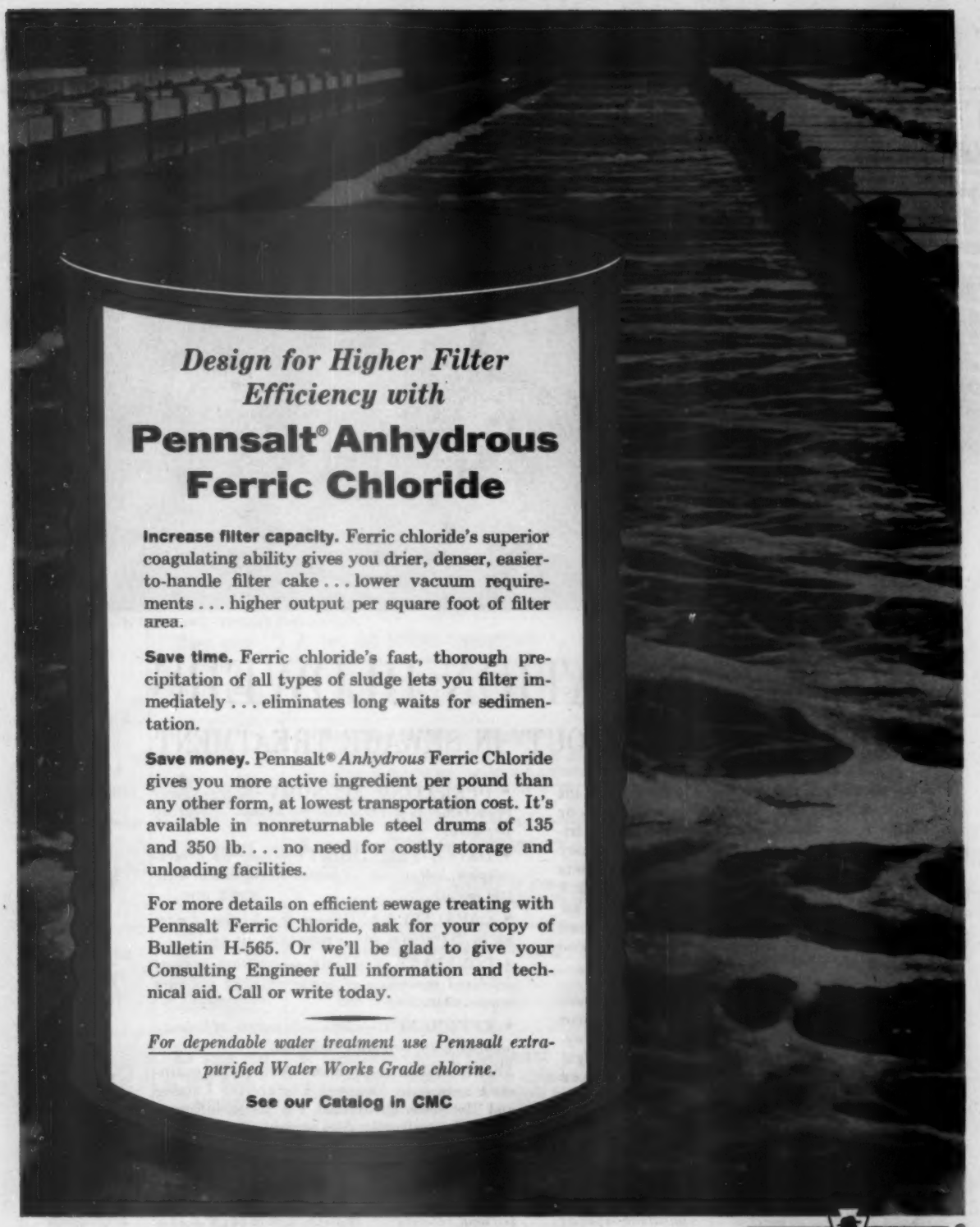
Roots rotary blowers adapt uniquely to the Kraus process utilized in the Toledo Sewage Treatment Plant. The same blowers are capable of supplying the four pound (high level) or the eight pound (low level) aeration systems. The "load following" characteristic of rotary positive displacement blowers results in power savings and minimum operating costs.

Design advantages of the Roots blowers selected for the Toledo plant include:

- SPEEDS—*conservative operating speeds contribute to quiet operation, low maintenance and long service life.*
- OPERATING ECONOMY—*horsepower requirements determined by actual operating pressure.*
- DRIVE FLEXIBILITY—*may be direct-coupled, belt-driven or geared to engines or electric motors.*
- CAPACITY RANGE—*wide selection of sizes up to 25,000 cfm for pressures to 10 psi.*
- CONSTANT VOLUME — *constant volume delivered regardless of temperature or pressure requirements.*
- EFFICIENCY — *high volumetric efficiency assured with minimum slippage.*

Additional data about Roots-Connersville equipment appear in Chemical Engineering Catalog and The Sewerage Manual. For design information and specification data covering Roots rotary or centrifugal blowers, gas meters and vacuum pumps write or call your R-C Field Engineer, or write for the following bulletins: *Rotary blowers* . . . Bulletin RAS-158 or Bulletin RB-154; *Centrifugal blowers* . . . Bulletin 120-B-14; *Vacuum pumps* . . . Bulletin VP-158; *Gas meters* . . . Bulletin M-258.

ROOTS-CONNERSVILLE BLOWER
A DIVISION OF DRESSER INDUSTRIES, INC.
360 Mount Ave., Connersville, Indiana. In Canada—429 Adelaide St., W., Toronto



Design for Higher Filter Efficiency with

Pennsalt® Anhydrous Ferric Chloride

Increase filter capacity. Ferric chloride's superior coagulating ability gives you drier, denser, easier-to-handle filter cake . . . lower vacuum requirements . . . higher output per square foot of filter area.

Save time. Ferric chloride's fast, thorough precipitation of all types of sludge lets you filter immediately . . . eliminates long waits for sedimentation.

Save money. Pennsalt® *Anhydrous* Ferric Chloride gives you more active ingredient per pound than any other form, at lowest transportation cost. It's available in nonreturnable steel drums of 135 and 350 lb. . . . no need for costly storage and unloading facilities.

For more details on efficient sewage treating with Pennsalt Ferric Chloride, ask for your copy of Bulletin H-565. Or we'll be glad to give your Consulting Engineer full information and technical aid. Call or write today.

For dependable water treatment use Pennsalt extra-purified Water Works Grade chlorine.

See our Catalog in CMC

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Equipment News

CONTINUED FROM PAGE 34A

kit doubles as a carrying case, and is small enough to be carried as spare gear on all service trucks. Leaking bell and spigot joints, flanges, saddles, and caulked sleeves, as well as cracked valve bonnets and leaking threads can be quickly repaired by ordinary labor in a minumum of time with this kit, and it is particularly recommended for minor repairs in hard-to-get-at places. The especially proportioned materials in the kit have also been thoroughly tested by Dresser to meet exacting requirements for regular maintenance as well as emergency repairs.

Application of this product is limited only by the imagination of the user, the company states, while at the same time the kit is packaged in such a way as to avoid expensive waste in the field. The package contains individual portions of resin, activator and fibrous reinforcer, as well as a collector ring and pressure relief vents for use during the "setting-up" period. Dresser sized the packages in such a manner as to eliminate guesswork in combining the correct proportions, thereby eliminating insufficient or excessive batches. The Util-Seal material can be mixed in the field in the resin can supplied in the package, stirred, and applied with a wooden paddle, also provided in the package.

While the company recommends a clamp or spoilt sleeve for repair of major splits and breaks in pipe lines, they felt that the newest developments in thermal plastics should be made available to their customers for special pipe repair applications.

Low Cost Sewage Treatment Plant

1018

Infilco Inc., Tucson, Ariz., has announced the availability of a new, low cost sewage treatment plant to serve subdivisions, industrial plants, motels, shopping centers and similar projects with population groups ranging from 75 to 3000.

Identified as the Acello-Biox plant, one type of this package unit for sewage treatment by the "total oxidation" method uses atmospheric oxygen to sustain the organisms which purify the sewage. A Vortair aerator entrains vast quantities of air, and mixes, recirculates sludge and clarifies within a single tank. Many states have approved this process for small installations.

Because this plant operates without air compressors, there is virtually

no noise and less power is required. Operation and maintenance requirements are minimal.

The Madison-Chatham (N.J.) Joint Meeting bags and sells their *Royerated sewage sludge cake*. While not big business, the operation does represent an additional source of municipal income.

The need for increasing municipal income, keeps growing in importance. The climate of today's economy warns against tax increases. Economies of operation are being searched for.

One of the most obvious economies that any organization can practice is the elimination of waste. Yet many sewage plants continue to dump or burn their sludge cake — throwing away or sending possible income up in smoke.

In April 1957, Royer published a new edition of their "Sewage Sludge Utilization Datalog," pointing the way to turning sewage from an expense into a profit. Since then, we've gone through two printings.

If your community is still destroying this source of revenue, write today—and learn how you, too, may experience *profitable sewage sludge* disposal.

Please send me a copy of your new edition of the information-packed "Sewage Sludge Utilization Datalog."

Name_____ Title_____

Plant_____

City_____ Zone____ State____

☐ I am interested in a demonstration of the Royer Shredder at work.

ROYER FOUNDRY & MACHINE CO.

ROYER

170 PRINGLE ST.
KINGSTON, PA.

"He musta misunderstood Gran'maw. She told him Tyton is easy to handle!"

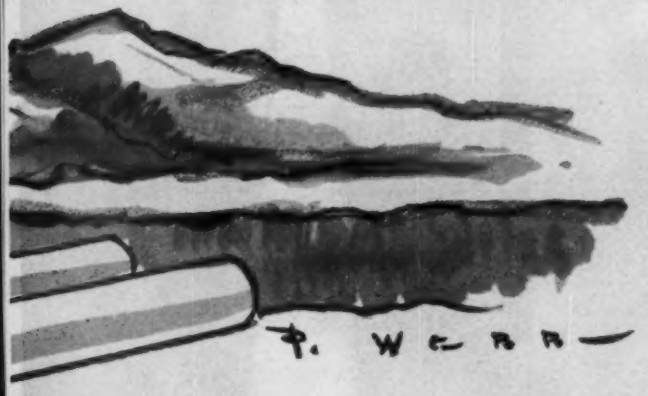
U.S. cast iron PIPE FOR WATER, SEWERAGE AND

losing no time!

Not Cousin Willie. He's used to working with Tyton® fastest, simplest, easiest to install pipe that ever snuggled into a trench.

No bell holes, caulking equipment, nuts, bolts or other bothersome equipment. Tyton Joint® pipe needs only one accessory. No weather worries, either. Tyton can be laid in rain or wet trench if need be.

Lose no time. Get the time and money-saving facts on Tyton Joint pipe. Call or write.



U.S. PIPE AND FOUNDRY COMPANY
General Office: Birmingham 2, Alabama

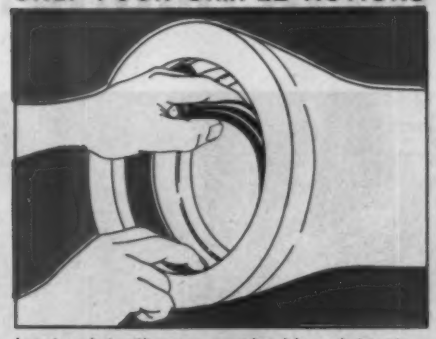
A Wholly Integrated Producer from Mines and Blast Furnaces to Finished Pipe.

INDUSTRIAL SERVICE

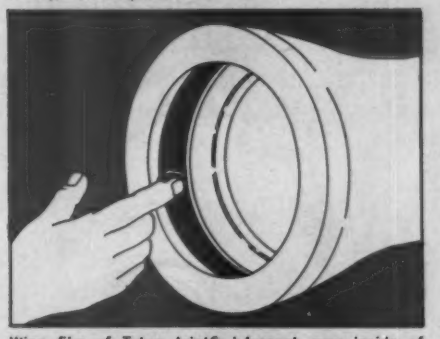
CAST IRON

TYTON®

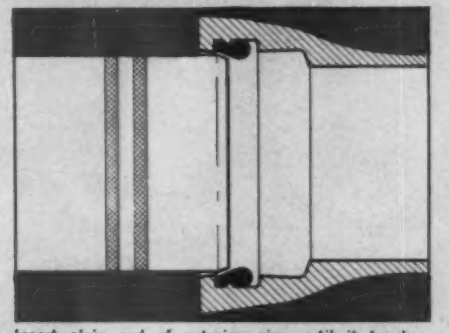
ONLY FOUR SIMPLE ACTIONS



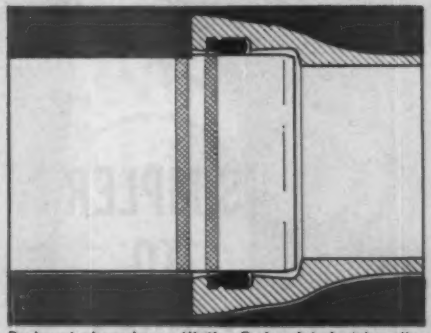
Insert gasket with groove over bead in gasket seat . . . a simple hand operation.



Wipe film of Tyton Joint® lubricant over inside of gasket. Your receiving pipe is ready.

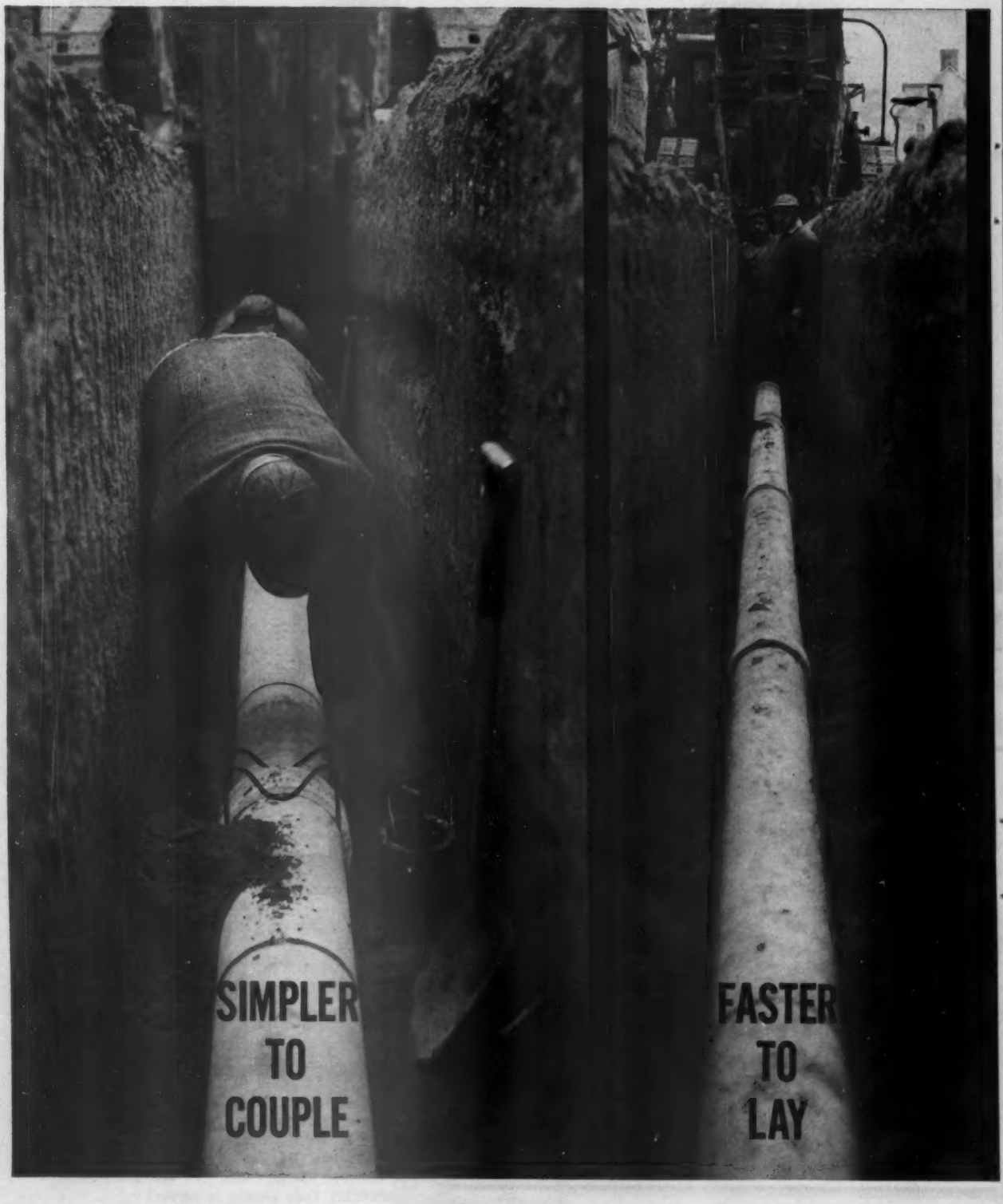


Insert plain end of entering pipe until it touches gasket. Note two painted stripes on end.



Push entering pipe until the first painted stripe disappears and the second stripe is approximately flush with bell face. The joint is sealed . . . bottle-tight, permanently! The job's done . . . . fast, efficiently, economically. Could anything be simpler?

"YOU'RE MONEY AHEAD WITH K·M BEST IN ASBESTOS



ASBESTOS-CEMENT SEWER PIPE!"

says prominent New Jersey contractor

. . . after laying more than 6 miles of "K&M" asbestos-cement sewer pipe

With the completion of the new sewer installation in New Jersey's thriving town of Marlton, Clyde Fear of Gray & Fear, contractors, had lots to say about "K&M" Asbestos-Cement Sewer Pipe. Here's what he told us. "You're money ahead with "K&M" Asbestos-Cement Sewer Pipe. Our men like the simple "K&M" couplings that slide in fast without any heavy machinery, and, believe us, that's one place where we save time and money. These simple coupling joints go miles faster. The pipe is easy to handle; there's less breakage on the job or in the storage yard. No lost time because of bad weather, either, because we can lay and couple this pipe in muddy trenches."

What Marlton, New Jersey, gained with "K&M" Asbestos-Cement Sewer Pipe, you can gain for your community, too. The pipe's smooth bore remains clean. This permits flatter grades . . . means fewer lift stations and lower pumping costs. It all adds up to less tax money for sewer installation and maintenance for your community.

Write today for more information on "K&M" Asbestos-Cement Sewer Pipe. Write to: *Keasbey & Mattison Company, Ambler, Pa., Dept. P-9100.*

FLUID-TITE COUPLING—an exclusive feature of "K&M" Asbestos-Cement Sewer Pipe. You simply lubricate the rings and slide in the pipe without heavy tools. The coupling is permanently tight, eliminates infiltration, and keeps out roots.

"K&M" Asbestos-Cement Sewer Pipe installation, Marlton, N. J.; Engineers: Sherman, Taylor & Sleeper, Merchantville, N. J.; Contractor: Gray & Fear, Woodbury, New Jersey.

Keasbey & Mattison at Ambler

Pipe plants at Ambler, Pa.—St. Louis, Mo.—Santa Clara, Cal.

ASBESTOS-CEMENT SEWER & PRESSURE PIPE

ARE YOU GIVING AWAY TONS OF WATER

...just to save a few cents?

The value of a water meter is not what it costs, but what it *earns*. Actually, its "bid price" is only your down payment, and could well be the only *easy* payment.

There are two reasons. First, like any fine instrument, a water meter loses accuracy as it wears. After a few years... or a few months... it begins to lose revenue. If you buy on price alone, you may soon find the meter giving away far more than the few cents you thought you saved.

Secondly, to keep the meter accurate, you may have high repair costs... or premature scrap-and-replace programs. Different makes of meters vary widely in this respect.

Water is your city's most vital service. You entrust it to the accuracy of your meters. To be sure of this accuracy, visit your meter shop. Ask which meter gives highest sustained revenue... with lowest repair and depreciation costs.

We sincerely believe the answer will be "Trident." 15,000,000 since 1898... the world's leader.

NEPTUNE METER COMPANY
LIQUID METER DIVISION

47-25 34th St. Long Island City 1, N. Y. / Neptune Meters, Ltd., 1430 Lakeshore Rd., Toronto 14, Ont. / Offices in Principal Cities

Vol. 107, No. 10 • October, 1960

A Scranton Gillette Publication

WATER & SEWAGE WORKS

A garden spot in the midst of a park is planned for the . . .

Pleasant Hills Sewage Plant

by JOHN W. TOWNSEND
WALLACE J. BECKMAN
Partner and Associate
Consoer, Townsend & Assoc.
Chicago, Ill.

EDITOR'S NOTE: This plant, when the landscaping now planned has been completed, should be one of the most eye-appealing treatment plants in the country. Located in a valley on a 5½ acre plot, the plant is designed to handle a 6 mgd peak flow, with provision for future facilities to handle an additional 6 mgd flow.

■ THE BOROUGH of Pleasant Hills is situated in the South Hills Section of the Pittsburgh metropolitan area. Their geographic position made it economically unfeasible to be included in the new Allegheny County primary treatment plant located on the Ohio River. On March 18, 1953, the Pleasant Hills Authority was formed, under the provisions of the Pennsylvania Municipal Authorities Act of 1945 as amended and supplemented, to study the problem of sewage treatment and arrive at a solution which would permit the construction of intercepting sewers, sewage treatment facilities, and the necessary appurtenances at the lowest unit cost to the tributary customers. Parts of Whitehall Borough, Baldwin Borough and

PIPE GALLERY illustrates a well defined system of color coding that is followed throughout the plant

Snowden Township as well as the Pleasant Hills Borough, adjacent to Pleasant Hills and likewise excluded from the Allegheny Authority service area, entered into a service agreement with the Pleasant Hills Authority for intercepting sewer and sewage treatment service.

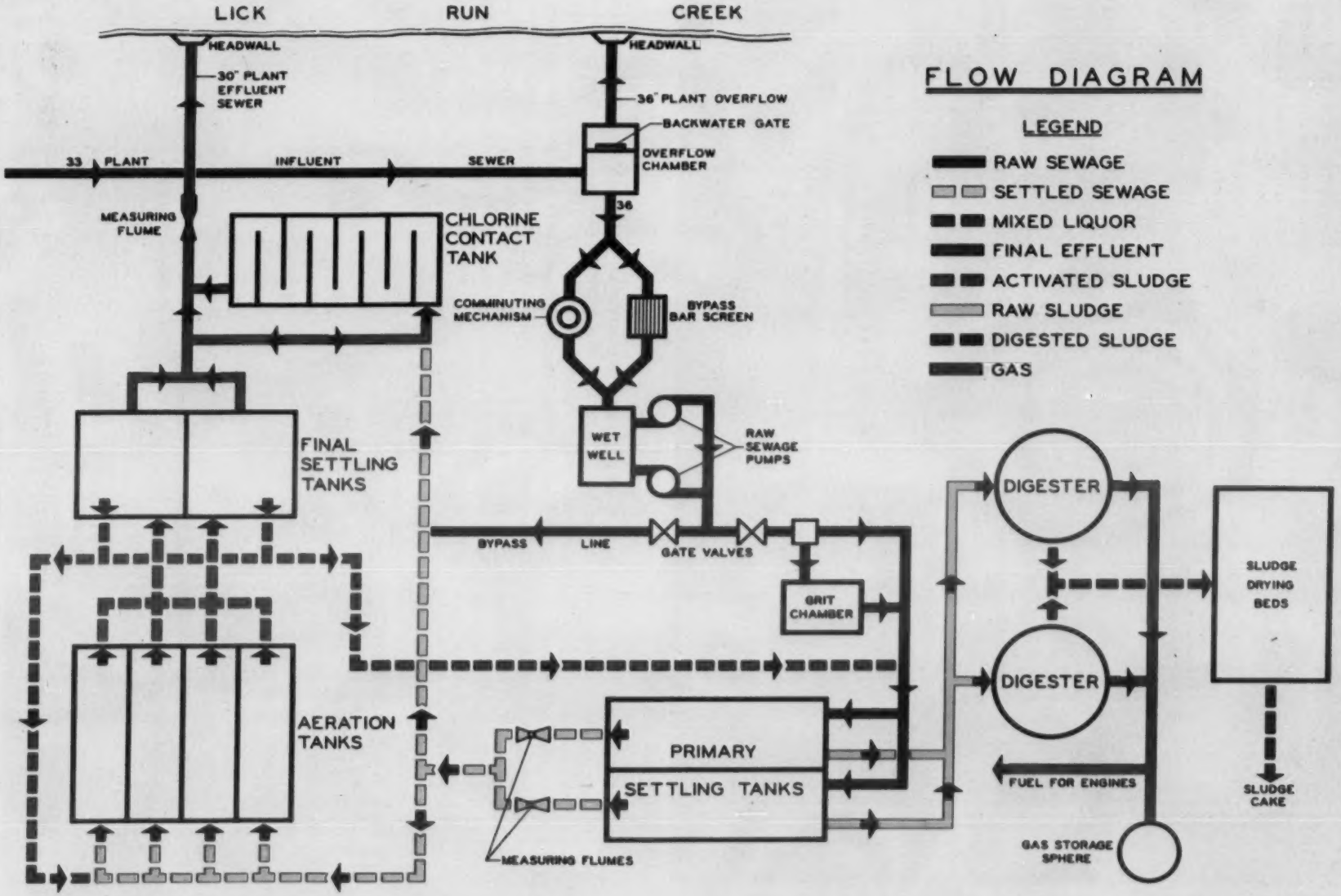
Engineering reports recommended the construction of a sewage treatment plant to provide for secondary treatment of the sanitary wastes tributary from a 1970 design population. A study of available sites resulted in the selection of a five and one-half acre plot of ground in Snowden Township at the entrance to the U. S. Bureau of Mines and Experimental Station. Plans and specifications were prepared for the intercepting sewers, sewage treatment plant and pumping stations and construction was started in March, 1958. The treatment plant and pumping station were placed in operation during September, 1959.

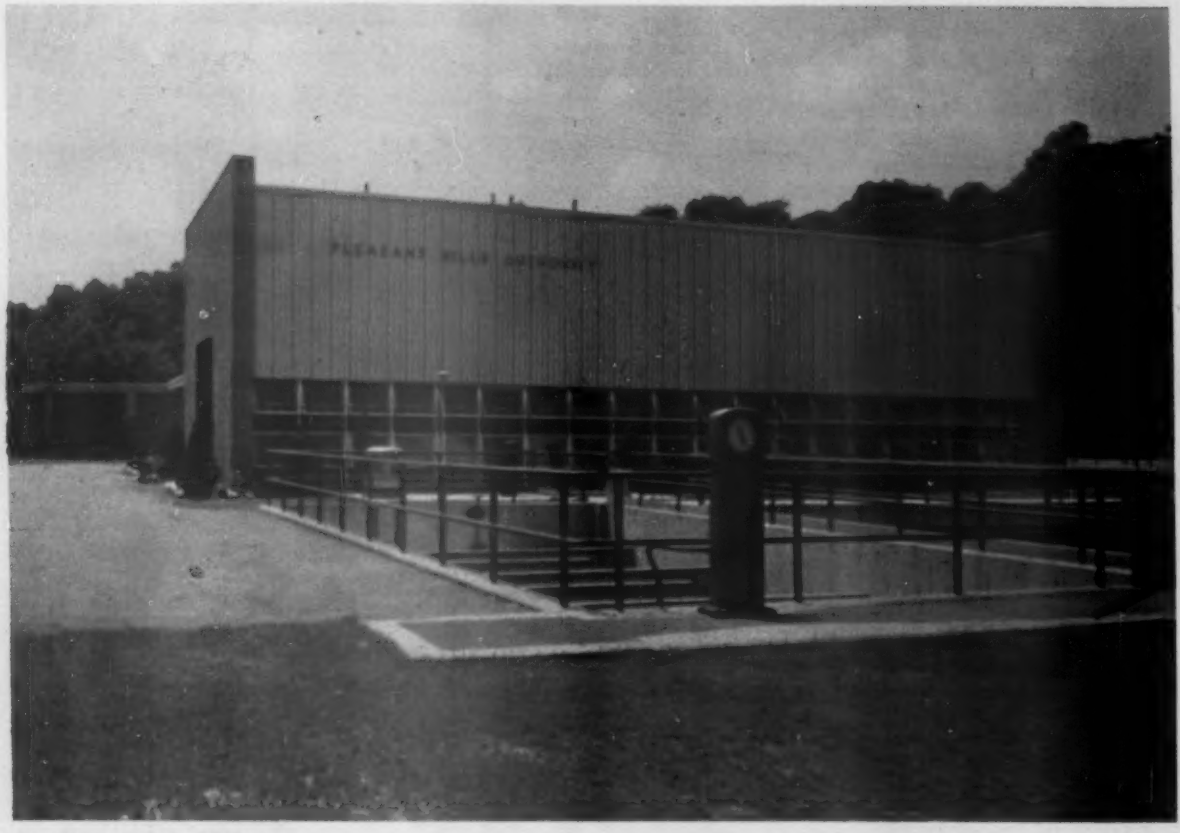
Plant Data

The 33 in. plant influent sewer discharges the raw sewage into a screen chamber located adjacent to the Main Equipment Building. The raw sewage flows through a comminuting sewage screen and into the raw sewage wet well. The comminution mechanism is sized to handle a peak sewage flow rate of 6.0 mgd. A comminutor bypass is provided with a manually cleaned bar screen. Provisions have been made to accommodate a future comminution mechanism sized to handle an additional 6.0 mgd peak flow rate.

The Main Equipment Building houses two Raw Sewage Pumps which lift the comminuted raw sewage from the raw sewage wet well to an aerated grit tank. Gas Engine driven variable speed pumps each with a pumping range of from 3.0 mgd to 9.0 mgd are provided. The pumping rate in operation is controlled by a float in the wet well so as to withdraw sewage from the wet well at the same rate as the raw sewage inflow. The gas engines are capable of driving the vertical sewage pumps, each requiring a maximum of approximately 50 Brake Horsepower Input, and have sufficient reserve capacity to drive pumps capable of handling anticipated future flows. The engines will be capable of continuous operation utilizing either sewage gas or natural gas, and are

RICHARD S. DODDS, Supt., checks on cleanliness of motor and pump to insure a high level of maintenance throughout


LICK RUN CREEK
HEADWALL
HEADWALL
30" PLANT EFFLUENT SEWER
36" PLANT OVERFLOW
BACKWATER GATE
33 PLANT INFLUENT SEWER
OVERFLOW CHAMBER
36
MEASURING FLUME
CHLORINE CONTACT TANK
COMMINUTING MECHANISM
BYPASS BAR SCREEN
WET WELL
RAW SEWAGE PUMPS
FINAL SETTLING TANKS
BYPASS LINE
GATE VALVES
GRIT CHAMBER
DIGESTER
DIGESTER
SLUDGE DRYING BEDS
AERATION TANKS
PRIMARY
SETTLING TANKS
FUEL FOR ENGINES
SLUDGE CAKE
GAS STORAGE SPHERE
MEASURING FLUMES
FLOW DIAGRAM
LEGEND
RAW SEWAGE
SETTLED SEWAGE
MIXED LIQUOR
FINAL EFFLUENT
ACTIVATED SLUDGE
RAW SLUDGE
DIGESTED SLUDGE
GAS



MAIN EQUIPMENT BUILDING

equipped with automatic alarm controls. The engines are also equipped with a crankcase positive ventilating system to prevent "acid action."

The raw sewage pumps discharge to an aerated grit tank. This grit tank is of the spiral flow type, 10 ft long, 16 ft wide, and has an average liquid depth of 10.5 ft. The total volume of 1,680 cubic ft provides a detention time of 4.0 minutes at the maximum design hourly flow rate of 4.5 mgd. Air is introduced through porous diffuser tubes placed about 2 ft above the bottom of the tank. Air to the tubes is carried through a swing type header which permits servicing the tubes without the necessity of dewatering the tank. The grit tank is equipped with a tubular conveyor which elevates the grit removed in the tank to a hopper above ground level where it is discharged into portable containers and hauled away for burial.

SEWAGE PUMPS in main building

Sewage flows by gravity from the grit tank to two primary settling tanks. Each primary tank is 25 ft 6 in. wide, 74 ft long, with an 8 ft average liquid depth. The combined volume of 30,200 cu ft furnishes a detention time of 1.81 hours at the design flow rate of 3.0 mgd. Each tank is equipped with straight line longitudinal and cross collecting sludge scraping mechanisms which scrape the settled solids to sludge hoppers at the influent ends of the tanks, and skim floating material to revolving type scum troughs near the outlet end. Sludge is withdrawn from the hoppers by gravity to a sludge well. Effluent from the settling tanks flows over a series of V-notch weirs installed at the outlet end of the tanks. The total length of weir provided in each tank is 100 ft.

The operating characteristics of the primary tanks are as follows under various rates of sewage flows: (Both tanks in operation.)

Primary Tanks

	Design Min.	Design Ave.	Design Max.
Flow Rates in mgd	1.5	3.0	4.5
Detention Period—Hours	3.62	1.81	1.20
Settling Rate — Gals/sq. ft./24 hours	400	800	1,200
Overflow Weir Rate—Gals/ft. of Weir/24 hours	7500	15,000	22,500

Return sludge from the Final Tanks is added to the settled sewage from the Primary Tanks at the entrance to a sludge mixing channel. The mixing channel provides an average mixing time of 1.8 minutes, based on a settled sewage volume of 3.0 mgd plus 25 percent return sludge.

Mixed liquor is introduced into the four spiral flow aeration tanks. Each tank is 21 ft, 10 in. wide, 119 ft long with a liquid depth of 12 ft, with influent sluice gates installed near the bottom of the mixing channel. Effluent from the aeration tanks flows over weirs into a concrete channel and then to the Final Tank center feed well through a measuring and flow balancing system.

The following tabulation of aeration tank characteristics is based on a design sewage flow of 3.0 mgd plus a rate of return sludge of 25 percent.

Aeration Tank Characteristics

Settled Sewage Flow	3.0 mgd
Return Sludge—25 percent	0.75 mgd
Total Mixed Liquor	3.75 mgd
Volume of Aeration Tanks	124,700 Cu Ft
Detention Period—Settled Sewage + Return Sludge	6.0 Hours
Detention Period—Raw Sewage Flow	7.5 Hours
On basis of 200 ppm BOD in Raw Sewage and 35% Removal in Primary Tanks:	
(1) Cu Ft of Aeration Tanks per Pound BOD added/24 Hours	38.3
(2) Pounds BOD/1,000 Cu Ft of aeration tanks/24 hours	26.1

Air for the aerated grit tanks, the aeration tanks and for channel aeration is supplied by blowers located in the Main Equipment Building. Two 3,000 cfm gas engine driven blowers are provided with space allotted for a third gas engine driven unit. Engines are capable of burning either sewage gas or natural gas.

Two Final Settling Tanks, 44 ft, 10 in. square and with a liquid depth of 10 ft, 8 in. are located adjacent to the Aeration Tanks. Aeration tank effluent flows through feed pipes and enters each tank through a center feed well. The final effluent flows over weirs and into troughs extending around the periphery of the tank. The total net length of V-notch weirs in each tank is 161 ft. The corners of the tanks are filleted to permit the operation of revolving type sludge collectors on the bottom of the tanks. Sludge is withdrawn to a sludge well from which point it is returned to the

ATTRACTIVE ARCHITECTURE and landscaping is shown at entrance of control building

MAIN CONTROL PANEL shows complete operation and maintains flow records

Final Settling Tanks

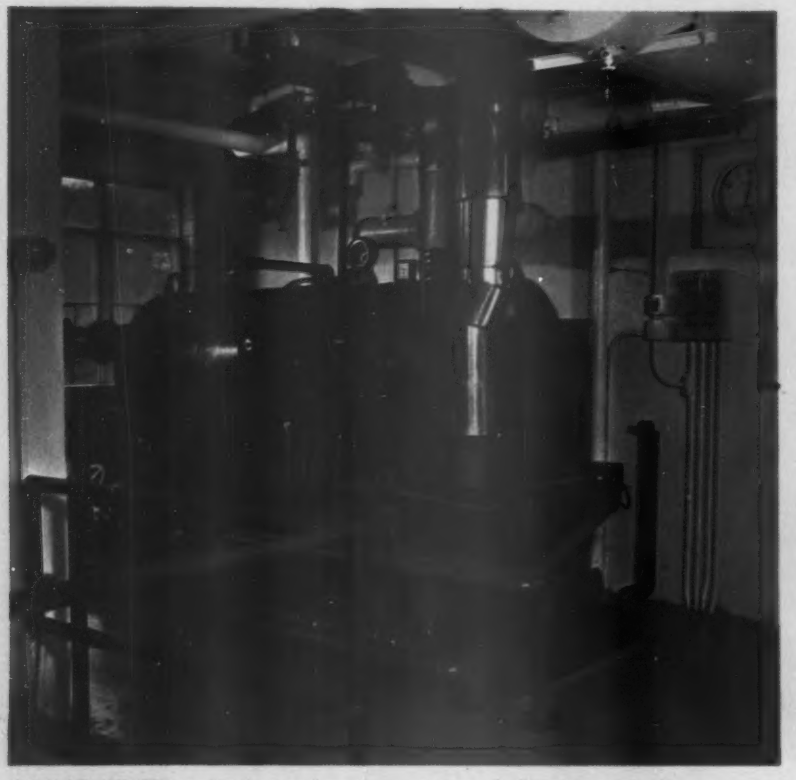
	Design Min.	Design Ave.	Design Max.
Flow Rates in mgd including 25 percent return sludge	1.88	3.75	5.63
Detention period—Hours	4.11	2.06	1.37
Settling Rate—Gallons/sq ft 24 Hours (including return sludge)	466	932	1398
Overflow Weir Rate—Gals./lin. ft of Weir/24 Hours	4660	9320	13980

Aeration Tanks or wasted to the Primary Tanks by the return sludge pumps. The operating characteristics of the Final Settling Tanks at the design period with both tanks in operation will be as above:

Two variable speed return sludge pumps are provided for pumping activated sludge to a sludge division box from which sludge flows by gravity to the mixing channel or to the primary tank influent channel.

Adjustable sludge withdrawal valves are provided at the Primary Settling Tanks. Flow from each of these valves is visible to the plant operator to permit control of withdrawal rates and sludge density. Sludge flows through the valves to a sludge well, from which point it is pumped by sludge pumps located in the Main Equipment Building through an external type heat exchanger into the two digesters. The digesters are equipped with floating type steel covers. The digesters are 65 ft in diameter with an average effective side water depth of 21.0 ft. The digesters are constructed of reinforced concrete with the sidewalls above grade insulated by a brick veneer separated from the tank by a dead air space.

Provisions have been made in the piping layout to introduce raw sludge near the center of the tank and at opposite sides near the periphery, and to withdraw sludge for circulation from the center of the tank and from the side near the Main Equipment Building. Digested sludge is drawn from the bottom at the tank center. Supernatant withdrawn through 3-6 in. inlet pipes in each digester set at different levels flows to the raw sewage wet well and is pumped with the raw sewage through the plant. Provisions have been made so that supernatant can also be introduced directly to the aeration tanks. An external type sludge heater is provided in the Digester Control Building to raise the temperature of the raw sludge and maintain optimum temperature of the digester contents. Sludge pumps are provided to recirculate the contents of the digesters through the heater when the temperature of the sludge drops below a pre-determined level. Interlocking controls are provided so that the circulating pump will run at such times as the raw sludge pumps are discharging raw sludge to the digesters. Two raw sludge pumps are provided, each with a capacity of 150 gpm, to pump primary tank sludge from the sludge wells at the Primary Tanks to the digesters.



SLUDGE HEATER maintains optium temperature of digester contents

Sewage gas is collected under the digester covers and conveyed either to the Digester Control Building for utilization in sludge heating, gas engine operation and building heating, or stored in a gas holder. Gas in excess of these requirements is burned in the waste gas burner.

Digested sludge is dried on open air sand drying beds. A system of underdrains collects the drainage and conducts it to the raw sewage wet well. Sludge bed area is 53,100 sq ft, providing an area of 1.77 sq ft per capita (design period).

Effluent from the final settling tanks

flows to a chlorine contact tank. The chlorine contact tank is 20 ft wide, 46 ft, 6 in. long, and has a liquid depth of eight ft. The total volume of 7,440 cu ft will allow a detention time of 17.8 minutes at the maximum design flow rate of 4.5 mgd and 26.7 minutes at the average design flow of 3.0 mgd. Chlorine handling and application equipment furnished have a capacity of 400 pounds per day. Two chlorinators, each having a capacity of 400 lbs/day are provided. Storage space for 6 one-ton chlorine cylinders is available. This provides for a 30-day chlorine supply at the design period.

Flow from the Chlorine Contact Tank passes through a Parshall flume and outfall sewer before discharging into Lick Run Creek.

The Main Equipment Building houses the engine driven raw sewage pumps and blowers, the raw sludge pumps, the return activated sludge pumps, the chlorinator water pumps, the spray water pumps, the protected water pumps and tanks, air compressors, electric control panels and meters used in control of the process and other control equipment. To the south of the Main Equipment Building is located the Administration Wing containing an office, a complete and modern laboratory, a locker room, and a work shop. Adjacent to the office building is the Chlorine Room and the Chlorine Storage Platform.

AUTOMATIC PUMPING STATION lifts sewage over mountain to the main plant

CHLORINE ROOM provides complete handling facilities separated from main plant

The engine jacket water system serves several purposes. In addition to furnishing cooling water to the gas driven engines, this system supplies hot water to the sludge heater to heat the contents of the digesters, to the building radiators for winter heating of the plant structures, and to the hot water heaters to provide hot water for plant use. Cooling of the system is accomplished through the use of a coil located in the aeration tank influent channel.

The entire treatment plant site has been landscaped by the plant personnel in accordance with a long-range professional landscape plan and planting schedule. One of the first problems encountered in preparation of the grounds for landscaping was the hard clay soil. By adding granulated slag, and several layers of grit from the plant, the hard clay has been turned into a soft, workable top soil.

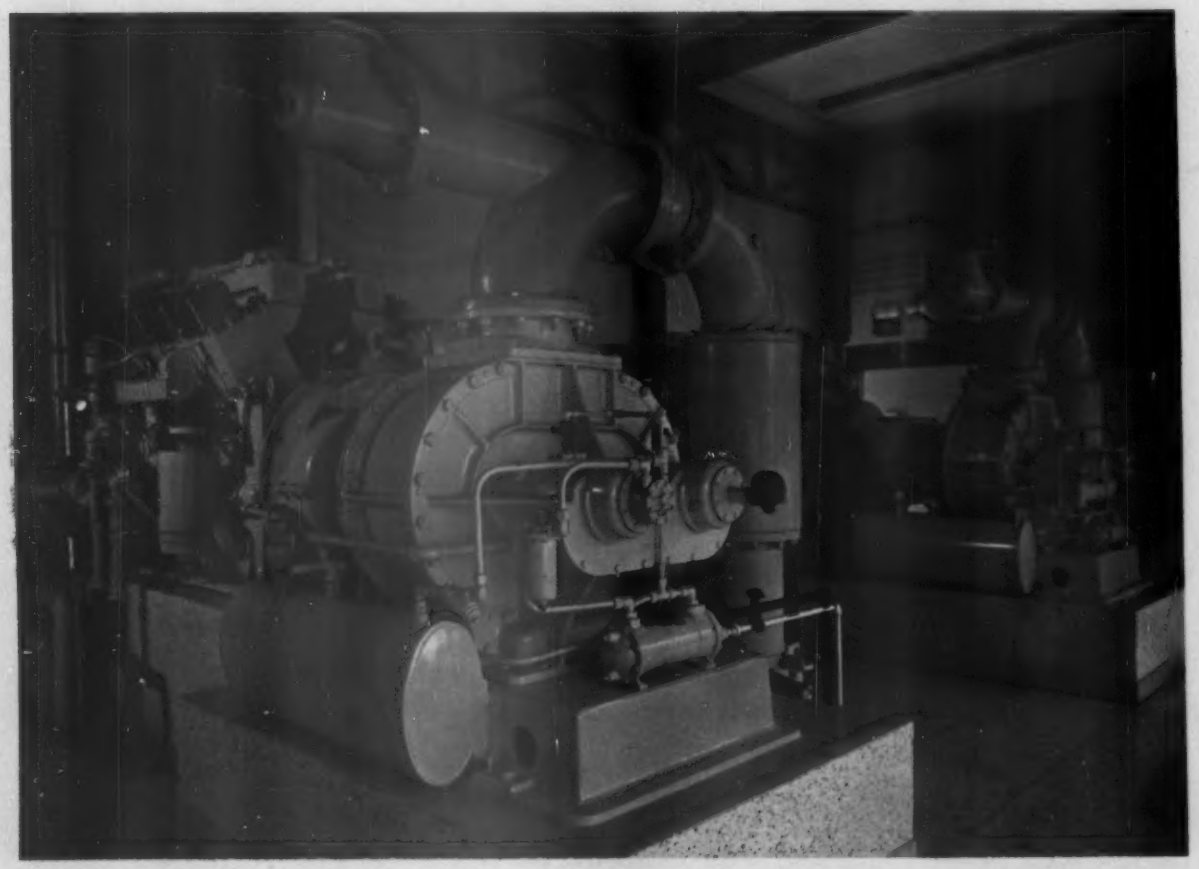
Granulated slag was also used in backfilling and the concrete mix. Japanese cherry trees have been planted along the entrance road; French lilac bushes have been placed along the fence separating the site from the railroad right-of-way. Japanese yews, arbor vitae, pfitzers, azaleas make up the basic plantings around the buildings and digesters. Additional flowering shrubs are in evidence throughout the site. Over 500 tulip bulbs were in bloom this spring. The landscape plan calls for honeysuckle plantings along each bank of Lick Run Creek, as well as other plantings which will thrive in the climate and soil at the site. Watering of the grounds is handled by pumping equipment and special spraying equipment which utilizes the final tank effluent.

The plant personnel consists of Richard S. Dodds, the plant superintendent, a chemist, and five full time operators who handle all ordinary maintenance, repairs and housecleaning chores. All the basement floors and walls have been painted, thus requiring a minimum of cleaning. The personnel have attended operators' school and have been trained in the operation and maintenance of all plant equipment.

The treatment plant, pumping station, and intercepting sewer system is operated by the Borough of Pleasant Hills under a lease-back agreement with the Authority. An estimated budget of $76,500 was set up for the year 1960. First quarter operation report indicates an annual expenditure of approximately $65,000 per year. The average annual rate per residential customer will be about $50-55 per customer for intercepting sewer and sewage treatment.

Major Equipment Items:

Sewage Screens—Chicago Pump Co.
Grit Removal Mechanism—Chicago Pump Co.—Hapman-Dutton Co.
Primary Tank Collectors—Chain Belt Co.
Air Diffusion Equipment—Chicago Pump Co.
Final Tank Collectors—Chain Belt Co.
Digester Covers—Pacific Flush Tank Co.
Gas Storage Sphere—Pittsburgh-Des Moines
Raw Sewage Pumps—Worthington Corp.
Engine Drives—Climax Engine
Raw Sludge Pumps—Chicago Pump Co.
Pumps—Chicago Pump Co.
High Head Pumps—Chicago Pump Co.
Magnetic Drives—Electric Machinery Co.
Blowers, Engines and Accessories—Roots Connersville & Climax Engine
Air Filters—American Air Filter Co.
Chlorination Equipment—Fischer & Porter
Meters—Builders-Providence
Blower Air Temp. & Press—Minneapolis-Honeywell
Meters—Foster Engineering Co.
Gas Meters—Pittsburgh Equitable
Cranes & Hoists—Louden
Sludge Heater—Chicago Pump Co.
Compressors—Worthington Pump Co.
Gas Equipment—Pacific Flush Tank Co.
Reducing Valves & Regulators—Fisher Governor Co.
Major Gate & Check Valves—M&H Valve & Fitting Co.
Rotating Sludge Valves—Pacific Flush Tank Co.
Gates & Operating Stands—Armco-Pekrul
Backwater Gate—Armco—Pekrul
Automatic Cone Check Valve—Hydraulic Div. Allis Chalmers
Chlorine Scale—Fairbanks-Morse
Office, Laboratory & Record Room Furniture—Art Metal
Laboratory Furniture—E. H. Sheldon Co.
Laboratory Equipment & Supplies—Central Scientific Co.
Electric Motors—Continental Electric Mfg. Co.
Vari-Drives—U. S. Electrical Motors
Right-Angle Gear Drives—Johnson Gear & Mfg. Co.
Valve Actuators—Hannifin Corp.
Oildex Filters—Oildex Corp.



MAIN ENGINE ROOM shows engines and blowers, other engines operate pumps

80th Annual AWWA Conference gets latest information on progress in . . .

Water Desalting

■ AT THE 80th Annual Conference of the AWWA at Bal Harbour, Florida, a variety of subjects was covered by the technical papers. The interest shown was indicated by the fine attendance, not only at the sessions of the various divisions, but also at the open committee meetings. A resume of some of these informative and timely papers has been prepared for the benefit of those readers who were unable to attend the meeting or particular technical sessions.

Progress in Water Desalting was reported on by Allen Cywin, Assistant director for Demonstration Plants of the Office of Saline Water, U. S. Department of the Interior, Washington D. C., and Lewis S. Finch, Vice President and Chief Engineer, Indianapolis Water Co., Indianapolis, Indiana. There has been some knowledge of sea water conversion for many years but the needs of the naval vessels and the armed forces during the sea and amphibious operations in World War II led to many improvements. Since then, the increasing awareness of the growing demands for fresh water has focused attention on the possibility of desalting brackish and sea waters contiguous to or underlying most of the fresh-water-short areas of our country.

Because the methods available after the end of World War II were very expensive, little progress was made until the passage of the first Saline Water Act in July of 1952. This act authorized the expenditure of no more than two million dollars for a five year exploratory research program. The law was amended in 1955 to extend the research and development program over a ten year period at a total expenditure not to exceed ten million dollars.

This Federal saline water conversion research and development program is being administered by the Office of Saline Water of the Interior Department. Both educational institutions and private industry are encouraged to participate in the program. Private industry operates under contract with the Interior Department. This cooperative program has spurred national and international interest in improving existing methods and developing new techniques for saline water conversion. In fact, the modest government program has been substantially augmented by contributions and independent research programs of private industry. This has led to the development of improved civilian type saline water plants which are being installed in increasing numbers throughout the world.

The various saline water conversion processes fall into five general categories: distillation, membrane, freezing, chemical, and others, and in each of these divisions, several variations have been investigated and developed. Many appear to be economically feasible and, because of the promise of ultimate economic results, Congress passed the Saline Water Demonstration Act, which was signed on September 2, 1958, to "transform experiments into production tests on a scale not possible of achievement otherwise". This Demonstration Program responsibility was assigned to the Office of Saline Water, now under Director Arthur L. Miller.

The Demonstration Act provides for the construction on the West, East, and Gulf Coasts of at least three sea water conversion plants, two of one million gallons per day capacity each. Two demonstration brackish water conversion plants, one of which is to be at least 0.25 mgd in capacity, have been authorized, one to be located in the "Northern Great Plains" and the other in the "arid areas of the Southwest". Each plant is to be designed to demonstrate a different process which the Secretary of the Interior shall select from the most promising of the presently known processes for sea and brackish water conversion.

A special Process Selection Board was appointed to assist in appraising and recommending demonstration processes from among those available. The processes selected by this board are:

1. Multiple-effect long tube vertical distillation (1 mgd)
2. Multi-stage flash distillation (1 mgd)
3. Electrodialysis (0.25 mgd)
4. Forced circulation vapor compression distillation (0.25 mgd)
5. Freezing (0.1 to 0.35 mgd)

Since the passage of the Demonstration Act, nearly 200 communities from every coastal state and many inland states have asked to be considered for one of the five plants. This so increased the difficulties of site selection that an independent Site Selection Board was appointed. After applying certain disqualifying factors to some of the applicants, the remaining sites were evaluated in accordance with a 1,000 point "Site Selection Schedule". After screening and preliminary grading, a group of the very best sites is chosen for personal inspection by the Site Selection Board. Following this final site inspection, the remaining candidates are re-screened and regraded. A formal report making final recommendations is then made to the Secretary of the Interior.

To date, four sites have been selected. They are:

1. Freeport, Texas, for process No. 1.
2. San Diego (Point Loma), California for process No. 2. This plant may be a combination saline water conversion plant and nuclear reactor. Be-

cause of objections to this location by the Atomic Committee on Reactor Safeguards, a site near Oxnard, in Ventura County, California, has been chosen as an alternate in case the combination plant is built.

3. Webster, South Dakota, for the 0.25 mgd electrodialysis plant.
4. Roswell, New Mexico, for process No. 4
5. Somewhere on the East Coast for a freezing process. More than forty community applications (from every Atlantic state) are being studied.

The first three plants are to be completed in fiscal year 1961 and the last two in fiscal year 1962. Plans and specifications for the plant at Freeport, Texas, (W. L. Badger Associates are the designers) have been issued to interested parties. The Southern California plans and specifications are being prepared by the Fluor Corporation and the Webster, South Dakota, specifications are being prepared by the Bureau of Reclamation.

By law, the plants are to be operated under contract with the Government until September 2, 1965. They are then to be disposed of to the highest bidder, or as Congress may otherwise direct.

As more and larger saline water conversion plants are built for civilian use, the costs have been decreasing from $4 to $5 per thousand gallons. The plants now under construction or being designed should produce water at close to $1 per thousand gallons in plant sizes of 1 mgd. It is not too unrealistic to predict a future cost of fifty cents or less per thousand gallons for saline water conversion.

J. F. D.

Water Quality and Water Treatment Plant Design Requirements in this country were reported on by Mr. William W. Aultman, of James M. Montgomery Consulting Engineers, Pasadena, California, Chairman of the Task Group appointed to canvas all of the State Sanitary Engineers on this subject. All of the fifty State Sanitary Engineers responded to the request for a copy of their state's requirements for water quality and water treatment plant design.

Most states, by reference, use the USPHS "Drinking Water Standards—1946" for water quality requirements. Those states that do not have published water treatment plant design criteria use it as their guide or refer to either the "Ten State Report", the AWWA "Manual of Water Quality and Treatment", or the ASCE Manual No. 19, "Water Treatment Plant Design". Many states prefer not to have any published design criteria because they feel that such criteria, when adhered to closely, would inhibit progress and prevent worthwhile innovations.

The problem then is how to establish criteria of water quality and treatment plant design which will provide sanitary engineers in the state Departments of Health the tools needed to determine the adequacy of facilities being prepared for water treatment and, at the same time, produce a document that will not be final and inflexible. Such criteria, published by a governmental agency, would create too much of an impression of authenticity and finality and make process improvements unacceptable by persons in public position. Once such a document is produced by a governmental agency, the criteria are too often accepted as being gospel truths that permit no shading in interpretation deviation, or modification.

It is recommended that the Purification Division should request the Board of Directors of AWWA to ask the U. S. Public Health Service to cooperate with the state Sanitary Engineers and with a committee from the AWWA to prepare in the near future, up-to-date "Drinking Water Standards" that will cover, realistically, the conditions found in many states where some localities do not have water that can be made to meet the existing "Drinking Water Standards" at a reasonable cost.

It is further recommended that the Purification Division request the Board of Directors of AWWA to try to arrange for joint participation with the ASCE to budget sufficient funds to employ a qualified engineer to draft a new, complete, manual covering criteria for water plant design. A joint committee of the best qualified men available should be appointed to review this draft. If joint participation with ASCE is not possible, AWWA should proceed on its own either to revise with a salaried engineer, "Water Quality and Treatment", expanding it to include the design criteria needed to cover the subject adequately, or to prepare a separate document including the design criteria only. The manual should give acceptable ranges in the design criteria and should state clearly and emphatically that local conditions and technical improvements could permit modification of deviation from the published criteria.

J. F. D.

Manganese in Water Supplies, a report by Mr. A. E. Griffin, Chairman of the Task Group investigating this problem, covered this subject in a very knowledgeable way. Manganese is a quite common ingredient in impounded water and in many well waters. Its detrimental effects are well known and it appears to be a growing problem, if the number of requests for information on its removal is any criterion.

Manganese is dissolved by both biological activity and by chemical processes. Since the amount of biological activity is influenced by temperature, the waters in the southern TVA lakes usually contain much more manganese than northern reservoirs. The character of the inundated soil also influences the manganese content. Manganese in river waters is almost always caused by iron mine drainage, bottom water discharge from reservoirs and industrial pollution. Reservoirs usually develop manganese troubles shortly after being placed in service. Manganese bearing well waters occur over most of the country.

Manganese is usually reported with iron regardless of their ratio. The limit has been 0.3 ppm iron or manganese. This is reasonable for iron but too high for manganese alone. Separate reporting of iron and manganese is being considered with the possibility of placing the acceptable limit for manganese at 0.02 ppm.

Manganese removing organisms

are being studied at the University of Illinois. It is suggested that their presence in water is a very sensitive indicator of iron and manganese. Also, new methods of determining manganese are being developed and the prevalent older methods are being studied.

In the filter plant, sand may become coated with a deposit several hundred microns in thickness, the color of which varies from dark mahogany to jet black. This will need cleaning only if there is evidence of bacterial activity. Just as is the case with iron, manganese may be stabilized by the use of 2.0 ppm of glassy phosphates for each ppm of manganese present.

Manganese removal from water may be accomplished by the manganese zeolite process or by oxidation. The manganese zeolite is the same as that used for iron removal, with a capacity of 0.09 lb. of iron or manganese per cubic foot. It requires 0.18 lb. of potassium permanganate per cubic foot for regeneration. The size of removal installations varies from small domestic units to large industrial and municipal pressure type installations, often in conjunction with sodium cation exchanger water softeners.

Oxidation is accomplished by air, chlorine, chlorine dioxidem, chlorine plus copper as a catalyst, potassium permanganate, upward pH adjustment with lime, and lime soda softening. Often, combinations of aeration with one or more of the other methods are used, especially if carbon dioxide and hydrogen sulfide are present. pH adjustment should be to above 8.0 for rapid oxidation. If chlorine is used, not less than 0.5 ppm free available chlorine should be maintained and the pH should be 9.0 or higher. Chlorine dioxide is often used but is rather expensive. It has been found that 0.2 to 0.5 ppm copper, added as copper sulfate, expedites the oxidation with chlorine. Aeration plus lime at a pH of 9.5 or with added chlorine below 9.5 is very effective. Potassium permanganate with lime is also used. In some plants the order of application of chemicals is very important. Coagulation aids with alum may also be used to advantage for setting the oxidized manganese. Settling should always be used, if possible, to avoid heavy filter loadings.

J. F. D.

A Comprehensive Study of Water Coagulation was the subject of a report by Dr. A. P. Black, Dept of Chemistry, University of Florida. This is the fifth progress report on this project. The effects of pH and polyelectrolyte coagulant aids on the coagulation of clay suspension were studied. In general, clarification with alum was best between pH 7.5 and 8.5 where the particles were negative. Fair coagulation was often obtained below pH 4.5 where the particles were nearly neutral.

The anionic coagulant aids improved coagulation at the optimum alum dosages; i.e., when sufficient alum was first added to neutralize or reverse the particle charge. The cationic coagulant aids improved coagulation where insufficient alum was present and also acted as the sole coagulant without alum. Cationic aids may reduce alum requirements and allow better control of the coagulation process.

In the investigation of the coagulation of calcium carbonate and magnesium hydroxide, it was found that, while $Mg(OH)_2$ is always positive, colloidal $CaCO_3$ was found to be negatively charged at pH 9.2 to 11.0. This normally negative charge was reversed in the presence of 80 ppm. of $MgCl_2$ or as little as 5.0 ppm. (as SO_4) sodium sulfate. Sodium hexametaphosphate inhibits this charge reversal. The effectiveness of the coagulant aids studied seemed to be independent of the charge neutralization or reversal.

The study of color removal from swamp waters indicates that with low alkalinity waters, some added alkalinity is necessary, especially when alum is the coagulant used. Ferric sulfate, on the other hand, hydrolyzes at a lower pH range and good coagulation may be obtained with low alkalinity waters that would require added alkalinity if alum were used. In both cases, optimum coagulation was accompanied by the reversal of the zeta potential from negative to positive. Also, the correlation between the zone of optimum coagulation, color removal, and charge reversal, was excellent. All of the data obtained is consistent with the assumption that the hydrolysis products of alum and ferric sulfate are more effective than the respective trivalent ions in reducing or reversing the zeta potentials of the floc particles.

The efficacy of four coagulant aids with alum and ferric sulfate was studied with widely varying results. One aided color removal but did not aid coagulation; however, when used alone it gave good results. One aided color removal at low dosages but inhibited it at high dosages. One was of little value in any way. No. 4 (activated silica), in 1 to 10 ppm. dosages, aided color removal with alum but, while 1 to 5 ppm. aided color removal with ferric sulfate, 10 ppm. appeared to increase the color.

The associated study of the determination of turbidity and color in water is continuing as is also the investigation of the nature of organic color in water. J. F. D.

A Study of Methods for the Determination of Detergents in Water was presented by Mr. H.P. Kramer, Chief, Training Program, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio, reporting for Mr. J. C. Vaughn, Chairman of the Task group concerned with this subject. The original purpose of the study was to evaluate several current procedures on a variety of samples but, since it was found that the majority of the cooperating agencies used the same procedure, the study is essentially a survey of a single method.

Forty-two agencies cooperated in this study. Only eight submitted results obtained by different analysts or by using comparative analytical procedures and these additional results are treated in the report as results from individual agencies so that 50 separate values are included. Forty-three of the fifty values are based on the same analytical procedure and no other method was reported more than once.

Three separate solutions comprising Sample VI, each containing carefully measured amounts of alkyl benzene sulfonate, were

distributed to the forty-two members of the Analytical Reference Service. A total of 150 individual determinations were performed on each of the solutions. The concentrations used were: (A) 0.39 mg/l in distilled water, (B) 2.22 mg/l in Cincinnati tap water, and (C) 1.31 mg/l in Ohio River water that had been settled for 24 hours and autoclaved for 15 minutes at 121°C. The method used for most of the samples was the Methylene Blue Procedure described in a previous report. (Jour. AWWA, Oct. 1958).

For Sample A, the mean recovery for all groups was 97%, seven agencies reporting perfect results and ten others obtaining concentrations within ± 0.01 mg/l of this amount. Half of the cooperating agencies obtained results within ± 0.04 mg/l of the mean. The mean recovery for solution B was 92% with a standard deviation of only ±0.18 mg/l. Half of all the agencies obtained results within ±0.13 mg/l. With solution C, the mean recovery was only 86% with a standard deviation of ± 0.205 mg/l. For all samples the results were uniformly low, although this tendency was more pronounced with the river water than with the tap or distilled water. Aging of the sample and biological activity are among the possible causes and this seems to be born out by a statistical study of the results for solution C. Interfering materials and absorption of the alkyl benzene sulfonate on solid surfaces are other possible causes of the low results.

Several curves and bar graphs accompany this report.

J. F. D.

The Recovery and Reuse of Alum Sludge was the subject of a paper presented by Mr. J. M. Roberts of Roberts and Company, Associates, Atlanta, Georgia, and Mr. Charles P. Roddy, Chemist, Tampa Water Department, Tampa, Florida. The possibility of reclaiming alum sludge has intrigued water works people for almost sixty years. It has been attemped several times and at least one patent has been issued for the process. In all cases, sulfuric acid has been used to redissolve the sludge. Actually, the process is relatively simple, the principal problem being that of concentrating the sludge to keep the volumes to be handled within a practical range.

At Tampa the treatment problem is principally that of color removal with alum, although at times lime is used for stabilization and/or softening. Alum dosages are relatively high. For example, in 1958, the dosages varied from 56 to 110 ppm. Experiments carried through laboratory, pilot plant and plant scale operation have demonstrated the feasibility of the process. Savings indicated by these tests are in the neighborhood of $27 per ton of alum or, from the standpoint of water treatment costs, almost $12 per million gallons, based on the treatment of the Tampa water supply. The next expansion of the Tampa purification plant will include facilities for concentrating the alum sludge and reclaiming it with sulfuric acid.

J. F. D.

Maryland Debates Consolidating Water Control Agencies

The consolidation of all water control agencies in Maryland, which now are handicapped by overlapping jurisdictions, into one unit was proposed to the State Board of Natural Resources. David Hume, a board member, who was appointed chairman of a committee of five charged with drafting legislation to create a new State Department of Water Resources and Conservation, made the proposal.

The Committee's assigned, however, does not entail the automatic endorsement of the Board. The plan was certain to draw objections from both members of the Board and other interested persons.

Hume, admitting his proposal would stir sharp controversy, stated that the measure would bring together the entire functions of the State Water Pollution Control Commission which deals with industrial pollution, the sanitary engineering projects of the State Health Department, and the water supply program of the State Department of Geology, Mines and Water Resources.

Later, the proposal was challenged by Dr. Joseph T. Singewald, director of the State Department of Geology, Mines and Water Resources. Dr. Singewald asserted that State law on the use of water is "as good or better than that of any other state".

He further declared that the State's water resources were bound inseparably to the geologic functions of his agency. Maryland law on the regulation of water uses, he continued, needs only one important change, the extension of coverage to irrigation, an area excluded with domestic use in the Water law of 1933, the last such bill enacted.

Dr. Singewald stated that the irrigation clause should be designed only to protect the user from the effects of temporary extravagance since the State has an "adequate supply if it is managed properly".

Hume contended that the State must exercise control over water pollution at every level, from "farm irrigation ponds to the city water supply".

Administering Texas' Water Supply Given Challenge

"Texas' Water Resources—A Challenge In Public Policy and Administration" is the subject discussed in a recent Public Affairs Comment, the bi-monthly publication of the University of Texas Institute of Public Affairs.

John T. Thompson, Institute research associate, wrote the article which contends that: "Texas today has, according to most recent studies, enough water to supply a much larger population and economic growth if it is put to its most efficient use. The technological and engineering knowledge and ability for obtaining full benefit from the state's water is available.

"The ingredient that is lacking and that is desperately needed is the creative will to apply this knowledge and to make the decisions with respect to state governmental policy and administration which are necessary to obtain this goal. The question is: Can the people of Texas so agree and compromise their differences as to reach these decisions?"

A report on the start of operations of the sludge treatment plant is in . . .

Startup of the Hogsmill Valley Sewage Works, Part 2

by H. H. STANBRIDGE and J. O'NEILL
General Manager and Deputy General Manager
Hogsmill Valley Joint Sewage Board
Kingston-upon-Thames
England

EDITOR'S NOTE: The sludge digesters presented only a minimum of problems with startup. Two months after filling began gas was being generated in sufficient quantity to permit the use of the gas fired sludge heaters. After six months the engines were shifted to dual fuel operation and within three more weeks the entire power station was operated on sludge gas. The two, stage digesters have produced a sludge free of unpleasant odors with good reduction in volatile matter but drying the sludge on open beds has been difficult. This problem has been complicated somewhat by an inadequate area for sludge drying. The existing beds supplied one square yard for each seven persons. New construction has reduced this loading. It is hoped that this will correct this situation. One part of the design of this plant which proved to be unfortunate is that one pipeline has to serve the dual function of transferring raw sludge from the pumping station to the primary digesters and digested sludge from the secondary digesters to the sludge drying beds. This keeps this pipe line busy all day and prevents charging the digesters more than once a day. However the most serious objection to a situation such as this is the lack of flexability. Very little can usually be done with such a set-up to try something new or to cope with unusual occurrences. This paper was originally presented before the Metropolitan and Southern Branch of the Institute of Sewage Purification and is printed here with the permission of ISP.

Sludge Treatment Plant
Digestion Plant

■ WHEN STARTING UP a digestion plant two methods are available: to fill the tanks with sewage and then add sludge as it becomes available, or to commence with empty tanks and then gradually fill them, one at a time, with raw sludge. In both cases partially digested sludge from the first tank to be filled can be used for seeding the raw sludge fed into the other tanks.

With the first method and with our design of tank it would have been possible to start heating and circulating the sludge immediately; whereas, with the second method, this would not have been possible until a tank had been almost filled. There would therefore have been less chance of a layer of scum forming on the surface during starting up with the first method. On the other hand, a partially digested sludge would have been discharged from the tank from the very first and this might have caused odor nuisance, although by filling the first tank only with sewage and using the overflow from this to fill subsequent tanks, such nuisance might have been avoided. With the first method, also, any seed sludge would have been greatly diluted with the sewage in the tank and might not therefore have been so effective. Also a large volume of very watery digested or partially digested sludge would have had to be dealt with in the initial stages and some time might have elapsed before a concentrated sludge was built up in the tanks.

We decided to employ the second method, a start being made on filling the first digestion tank in August, 1957. This took just over a month to fill, after which the tank stood for 2 to 2½ months while digestion was becoming established. It was then put into normal operation. Altogether, it took five months to fill the primary tanks, and a further two months elapsed before it became possible to put the plant on full load. We were fortunate in that during the starting up period the works was only treating a portion of the sewage flow for which it was designed so that less sludge had to be dealt with than would normally have been

Courtesy of the English Electric Co Ltd

The primary digesters near the end of their construction

the case; also, that some of the sludge was from works employing biological filters and could therefore, as a temporary measure, be applied direct to drying beds without first undergoing digestion. Had it not been for this all of the primary tanks would have been filled in 40 days and for some months it would have been necessary to employ some other means of dealing with the sludge. Alternatively, a partially digested sludge would have been produced, involving possible odor nuisance and difficulties with dewatering. With a works starting up on full load it seems that lagoons are necessary for receiving the surplus sludge temporarily if operating difficulties are not to be experienced from the start. By the time we came to fill the secondary tanks the works was almost on full load and it took only five weeks to fill these.

While the plant was under construction, a quantity of sludge had been allowed to digest in a storm tank on one of the other works and this seed sludge, equivalent in volume to 16 per cent of the capacity of a primary tank, was of considerable assistance in starting up. Acidity was experienced only occasionally and when this occurred hydrated lime was added to the sludge being circulated. Altogether, only 1400 lbs of lime were used in doses of 200 lbs at a time.

A considerable amount of foaming was experienced during this period and foam overflowed the tank copings on a number of occasions. For this reason it is advisable that the surroundings of primary tanks should not be completed until after the tanks have been brought into full operation. With two of the tanks a 6 in. high wall was built temporarily on the coping around the gas bell to retain the foam; also at intervals sludge was withdrawn from a tank to provide storage space. No further raw sludge was added to a tank after it had once been filled until foaming had ceased. Incidentally, it would have been an advantage if the gas bell guide roller carriages and the low level alarm switches had been set above the foam instead of being fitted directly on the tank copings. One disadvantage of lowering the level to provide space for foam was that this permitted a layer of scum to form on the sludge inside the tank, but at intervals the level was raised by adding sludge from other tanks and the scum broken up and removed. At no time has any real difficulty been experienced with scum formation.

When gasification had become vigorous the manhole on the gas bell was sealed and all cocks were closed; the gas under the bell was then vented to atmosphere several times, the composition of the gas being tested with an Orsat apparatus each time. As soon as it was shown that no oxygen was present, the main to the water heaters was purged and a heater put into operation. Two months after commencing to fill the primary tanks gas was being used in the water heaters for heating the sludge and four months later sufficient gas was available for the engines to be converted to dual-fuel operation. Three weeks after this the power station was operating entirely on sludge gas.

Operation

Until recently the method of operating the primary tanks has been to add raw sludge every other day over a period of about five hours, two tanks being fed on one day and the remaining two the next, alternately. At present raw sludge is being added to each tank daily and it is being found that gas production is more steady. To make room for the fresh sludge, digested sludge is withdrawn through the bottom outlet to lower the level in each tank by about 9 in. Raw sludge is then admitted and the tanks refilled, any excess causing sludge to be discharged through the adjustable overflows and so to the secondary tanks. In the early days most of the sludge was withdrawn through these overflows but there was a tendency to foaming with this method. Tests were therefore made which showed that sludge withdrawn from the bottom contained about 2 per cent moisture and 5 per cent less organic and volatile matter than sludge withdrawn through the overflows, so now nearly all of the sludge is withdrawn from the bottom. The circulating pumps are in operation continuously throughout the twenty-four hours. The method of operating the secondary tanks is to partially empty and then refill each in turn. With two tanks this means that some of the sludge might have been in a tank only a short time before withdrawal. A third tank is now under construction and when this becomes available the three tanks will be used in rotation, when there should be less chance of short-circuiting. Very little water separates in the secondary tanks although excellent separation occurs when the sludge is applied to the drying beds. It is considered that two of the main factors affecting the separation of water in secondary tanks are non-uniform cooling of the sludge causing convection currents and too low a surface area/depth ratio causing hindered settlement of the sludge particles, and we are in full agreement with the view expressed by Winsor [4] that "secondary digestion tanks are best built in a shallow form with large surface area."

Performance

Experience with the plant to date indicates (1) that it is possible to

produce a sludge which is entirely free from unpleasant odor, (2) the reduction in dry solids and in organic and volatile matter compares not unfavourably with published results obtained at other plants in this country, but (3) that as a conditioning process prior to dewatering on open beds the results are disappointing. As surplus gas is not metered it is not possible to say whether gas production is satisfactory. Despite excellent drying weather during the past spring and summer, difficulty has been experienced with drying the digested sludge. Possible reasons for this are being investigated but it is considered that one of the main factors is that the sludge to be digested contains surplus activated sludge. Another possible factor is inadequate mixing of the incoming sludge with the contents of the primary tanks, the only provision for this being admission of the sludge at a tangent with the idea of causing rotation of the tank's contents. In our case there has never been any noticeable movement of the sludge when viewed through the inspection covers and the only evidence of movement was once when an overflow of foam at one point on the periphery moved to another point during the night.

Cleaning of Digestion Tanks

During the early days it was possible that rather large quantities of grit might have entered the digestion plant so after eighteen months of operation, as a lagoon was available for receiving the sludge, it was decided to take the opportunity of emptying the tanks. They were therefore emptied, one at a time. A layer of gritty sludge containing about 20 per cent organic matter and varying in depth from 4 to 9 in. was found on the floor of each primary tank, while in the secondary tanks a small quantity of grit was found to have accumulated under each inlet. No special provision had been made for removing grit, but by hosing it to the centre and then mixing it with sludge admitted under pressure from adjoining tanks and also by using water under pressure discharged through a hose attached to drain rods thrust up the outlet pipe, the grit was eventually removed. The difficulty of doing this, however, satisfied us that the provision of special means for entering a tank at floor level for removing grit would be worthwhile. This experience indicated that regular use of the bottom outlet for removing digested sludge from a primary tank was resulting in the floor being maintained fairly clear of grit.

A view of the secondary digesters

Before emptying a tank the manhole cover was removed and when the tank had drained down the air in it was tested with a gas detector lamp before a man entered equipped with harness and lifeline. No difficulty was experienced with gas at any time and purging was unnecessary. After a tank had been refilled the manhole was sealed and the gas under the bell vented to atmosphere several times until, when tested with the Orsat apparatus, no oxygen was shown to be present. The gas was then readmitted to the main.

Mechanical Equipment

The bottom bearings and sleeves of the sludge circulating pumps are subject to a considerable amount of wear due to their being continuously immersed in sludge. This was particularly noticeable during the early days when the sludge contained boiler ash from a power station. A cutlass rubber bearing was therefore fitted as an experiment, when it was found that wear of the sleeve was taken up by swelling of the rubber so that there was little play in the pump spindle. A nylon bearing is at present under test. Difficulty has also been experienced with shredded rag becoming wrapped around the vertical spindle and whipping the sludge into a foam so that it overflows the chamber, while at the same time throwing an unbalanced load on the motor. It is understood that in future schemes, suspended type pumps are to be used.

Another difficulty has been choking of the annular spaces of the heat exchangers. All of the sludge which is being circulated has to pass through 1 in. wide spaces and if these choke circulation ceases and sludge overflows while in the annular spaces themselves, sludge quickly commences to cake on the heating surfaces. Originally the raw sludge passed through one of the heat exchangers before entering a tank but so much trouble was experienced with choking, due mainly it was thought to the balling together of rag which had been shredded by the comminutors, that the design was altered and the heater bypassed. Recently, however, two of the original inlets have been replaced as it is considered that without preheating, digestion is being adversely affected. This has been possible because at present in normal dry weather most of the rag is being removed from the sewage by the temporary screen. After two month's operation there was 1 to 2 per cent less organic matter in the sludge withdrawn from the bottom of the tanks with preheating than in the sludge from the other two tanks, so arrangements were made to alter the remaining inlets. The heater spaces are of course brushed when required, special nylon brushes being used for this purpose.

The heat exchangers are connected to the flow and return pipes by 4 ft lengths of flexible copper tubing. After two years several of the tubes were found to be leaking so, as their renewal involved removing the deflector tube and lifting the heater element, a major operation, it was decided to fit 2 in. galvanized steel pipes with short flexible hose connections at the upper end in their place. These are much stronger and cheaper and the hose can be readily examined and renewed if necessary.

The dual fuel engines generator sets

The vacuum and pressure relief assemblies were unsatisfactory at first as the valves tended to stick and the seatings to corrode, with the result that they were not very sensitive and not always gas-tight. Owing to the large area of gas bell a small variation in gas pressure which might not be sufficient to make the relief valve operate causes a large variation in the upward pressure on the bell. The steel valve plates were therefore replaced with polyethene plates, then cast iron seat rings were fitted and later these were replaced by polyethene rings.

The flame traps on the gas reliefs have also not given very satisfactory service as they corrode and choke, so the existing copper traps are gradually being replaced with traps of stainless steel.

The gas-fired water heaters gave trouble to begin with due to insufficient draft; difficulty was experienced in lighting them and after they had been lit a back-draft was apt to cause the jets to be extinguished and gas to be vented into the building. This was overcome by extending the stacks.

Sludge Drying Beds

The area provided for drying the sludge was soon found to be inadequate. During 1958-59, with 1 sq yd of bed area for every 7 persons, it was only possible to deal with 44 per cent of the digested sludge on the beds, although special attention was paid to removing sludge from a bed as soon as it became suitable for lifting, and sometimes before, so that no time was lost. It must be admitted, however, that the weather during the summer and autumn of 1958 was particularly bad for drying. On the other hand, this year from April to July inclusive, with exceptionally good drying weather, it was found possible to deal with only 73 per cent of the sludge on the beds. Additional beds have therefore been constructed during this summer, increasing the area available to the equivalent of 4½ persons per sq yd.

A point to be borne in mind with digestion is that although it may lead to a reduction of 30 per cent or more in the weight of dry solids, the reduction in volume of the air-dried sludge is not so great. Unless this fact is appreciated estimates of labor requirements for removing the sludge from the beds and of the amount of dried sludge to be disposed of are likely to be too low.

Power Station

The first engine, to be converted commenced operating as a dual-fuel engine in March, 1958, 32 weeks after the works had started up, and from 28th March two engines have operated continuously on sludge gas except for short periods when insufficient gas has been available. During 1958-59, for instance, the engines operated on sludge gas for 98 per cent of their total operating time.

Fuel and Lubricating Oils. When first converted the proportion of diesel gas oil required for ignition purposes was about 11% of that required when running wholly on oil and on full load; i.e., 2.2 gals* compared with 18.5 gals per hour, but adjustments have enabled this proportion to be reduced to 6½ per cent, i.e.; 1.2 gals per hour. It might perhaps be mentioned that the amount of oil used for ignition is independent of the load on the engines. When the engines were subjected to a top overhaul after being in operation for 5,000 hours the interiors were found to be in excellent condition.

Corrosion in Cooling Water Circuits. During the first eighteen months a considerable amount of corrosion occurred in the cooling water circuits, necessitating the renewal of certain parts of the equipment. This was found to be due to alkalinity building up in the circuits as the result of using a base-exchange water softening process combined with evaporative type coolers. Other factors might also have been a temporary high concentration of chloride due to a defect in the softener, and ammonia in the cooling water associated with a high pH value. Provision was therefore made for blowing down water from the circuits to maintain an alkalinity between 500 and 1,000 mg/l. Test pieces of various metals have been placed in one of the coolers and these are being examined at intervals for further corrosion.

Isolation of Equipment for Maintenance and Repair. In arranging the layout of a power station it is important that it shall be possible to readily isolate any section for maintenance or repair. Soon after the station came into operation it was found necessary to fit isolating valves in the cooling water system and a bypass to the thermostatic mixing and diversion valve. On the electrical side, in our case it is not possible to attend to a main isolating switch without shutting down the whole of the plant.

*Imperial gallons are used through this paper

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New boilers to drive new pumps and generators are part of the . . .

Expansion of a Water Pumping Station in Australia

by J. GRINDROD
New Milton, Hants
England

EDITOR'S NOTE: Australia is also experiencing an increase in water demand. The growth of the area served by the Ryde Pumping Station in Sydney has increased the demand on the station in the last five years from 66 mgd to 75 mgd. The area actually served five years ago will by 1961 have a demand of 95 mgd but construction of a new 50 mgd pumping station which will take over part of the area is in progress. To increase the Ryde Station's capacity four pumping units were replaced with equipment of 50 percent greater power. These drive turbines will operate on 240 psi steam at 600°F. Increased output required the complete revamping of the suction and discharge lines. Dual 18 in. suctions connected to the two 60 in. suction lines feed the pumps which discharge into the pressure side manifold through 24 in. lines. From these manifolds water is carried to the reservoirs supplying the city. This expansion is expected to provide increased efficiency as well as capacity.

■ In order to meet partially the rapidly growing demands for water from the northern suburbs of Sydney, Australia, the Metropolitan Water, Sewerage and Drainage Board is modernising and expanding its Ryde Pumping Station to give it a capacity of 75 mgd. The Board is also constructing a new reservoir and a new pumping station at an existing reservoir which, in due course, will provide another 50 mgd of water.

Water for the north side of Sydney, is pumped direct from the Ryde Pumping Station to seven primary reservoirs at Hermitage, Chatswood, Killara, Pymble, Wahroonga, Beecroft and Mobbs Hill, Fig. 1, from which it is delivered either by further pumping or by gravity to other reservoirs. Between them, these storages serve an area whose population is approximately 486,000.

Dating back to 1892, the original Ryde Pumping Station, Fig 2, was

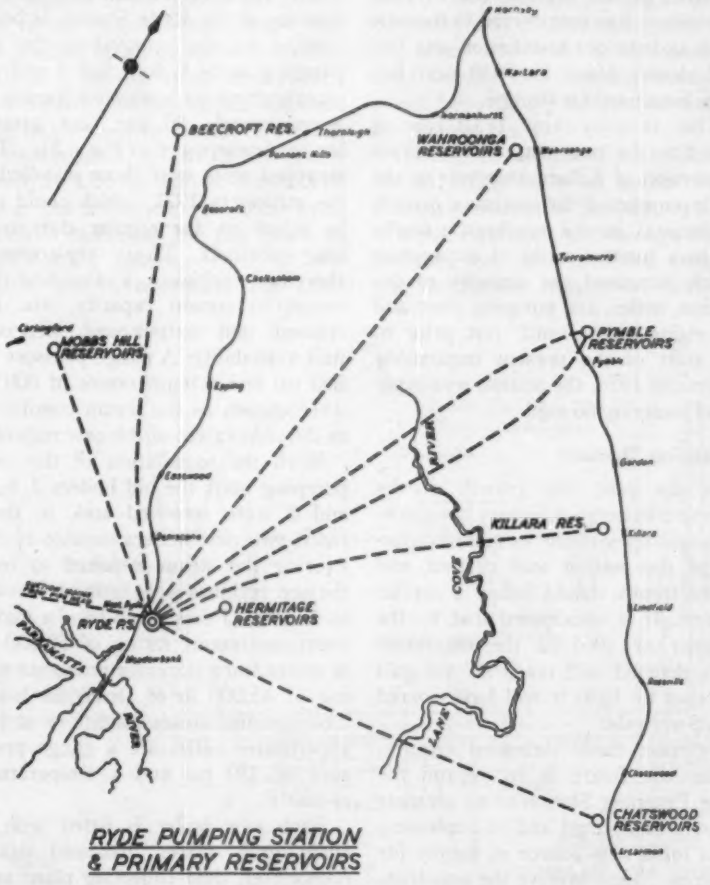

FIG. 1. LAYOUT map showing the locations of the reservoirs connected to the Ryde Pumping Station.

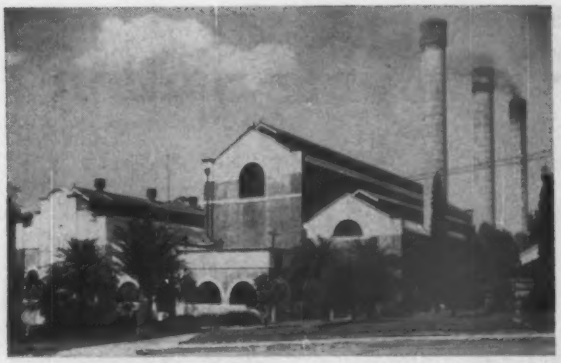

FIG. 2. EXTERIOR VIEW of the Ryde Pumping Station Sydney, Australia.

FIG. 3. ONE OF THE NEW turbines in the engine room.

superseded in 1921 by a larger plant which comprised four steam turbine-driven pumping units, two 300 kw turbo-generators sets and eight B and W boilers arranged in batteries of two, and known as boilers Nos. 1 to 8. Two of the pumping units, 5 and 6, delivered water to Chatswood and two, 7 and 8 to Pymble. At that stage, pumping to Hermitage, Mobbs Hill, Beecroft and Wahroonga was carried on from the old station, but in 1927 Hermitage was transferred to the new plant and the old installation was finally closed down in 1930 and has since been used for storage.

The step-by-step transfer of duties to the new station, the direct connection of Killara reservoir to the Ryde pumps and the continued growth in demand in the northern suburbs led to a further series of expansions which increased the capacity of the suction, boiler, and pumping plant and the rising mains until, just prior to the start of the present expansions scheme in 1956, the station was capable of pumping 66 mgd.

Expanding Demand

In the past, the growth of the northern suburbs of Sydney has quickly caught up with the increased capacity of the station and current and future trends should follow a similar pattern. It is anticipated that by the summer of 1961/62 the maximum day's demand will reach 95 mil gals and that by 1980 it will have soared to 125 mil gals.

To meet these increased requirements, the Board is to expand the Ryde Pumping Station to its ultimate capacity of 75 mgd and to implement plans for a new source of supply for the area. These involve the construction of a new pumping station at Prospect Reservoir and the provision of a reservoir at Thornleigh. Together, these will ultimately be capable of contributing 50 mil gals to the maximum day's demand. The Prospect-Thornleigh scheme, upon the first stage of which work has now begun, will take over from Ryde the supplying of Beecroft and Mobbs Hill reservoirs.

New Pumping Units

The required increase in pumping capacity at the Ryde Station is being effected by the removal of the old pumping units 5, 6, 7 and 8 and replacing them with new equipment of approximately 50 per cent greater brake horsepower (Fig. 3). The scrapped units were those installed in the station in 1921, which could not be relied on for regular duty over long periods. Their replacement, therefore, achieves a two-fold increase in station capacity, viz. increased unit output and increased unit availability. A gauge pressure of 240 psi and a temperature of 600°F were chosen as the steam conditions at the stop valves of the new turbines.

With the installation of the new pumping units the old boilers 5, 6, 7 and 8 were removed and, in their place, two new boilers capable of delivering the steam required to feed the new turbines were erected. Known as 12 and 13 these each have a maximum continuous rating of 50,000 lb of steam and a normal continuous rating of 45,000 lb of steam an hour. The specified steam conditions at the superheater outlet are a gauge pressure of 250 psi and a temperature of 650°F.

Each new boiler is fitted with a chain grab stoker, balanced draft, economiser, dust collecting plant and a pneumatically operated automatic control system.

Because of the greater output of the new pumping units, the piping and fittings between the suction mains and the pumps, and between the pumps and the rising mains had to be renewed.

On the suction side, each pump is fed from a pair of 18 in. saddles, one on each of the 60 in. suction mains (FIg. 4). The valves that had been removed from the piping to the old units were bolted to the flanges of these saddles. New piping, comprising a 24 in. pipe at the pump end and two parallel 18 in. pipes at the suction main end, connect the valves with the pump suction flange.

On the delivery side, 5 and 6 units will be connected to the Hermitage, Chatswood and Killara rising mains and 7 and 8 units to the Mobbs Hill, Beecroft, Pymble, Wahroonga and Killara rising mains.

From the delivery flange of each pump 24 in. steel pipes pass through the engine room floor Fig 5 and Fig 6 to a reflux valve, thence through the eastern wall of the station horizontally over the rising mains along a centre line approximately 7 ft above ground level. The Hermitage, Chatswood, Pymble, Wahroonga and Killara rising mains will be connected directly to the 24 in. horizontal pipe from the pump delivery, through vertical legs each with a hydraulically operated gate valve. The vertical legs will be either 18 in. or 24 in., depending upon the rate of pumping through each connection and upon how often it is likely to be used.

Since the delivery pipes from the new pumping units emerge from the eastern wall of the engine room toward the northern end of the station and the Mobbs Hill and Beecroft rising mains leave from the western side of the engine room at the south-

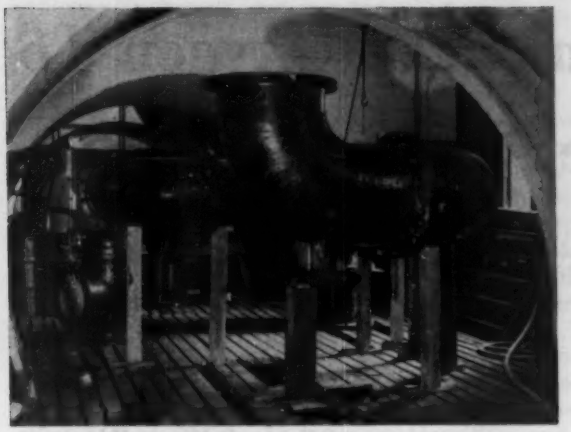

FIG. 4. TYPICAL SUCTION PIPING in the process of installation.

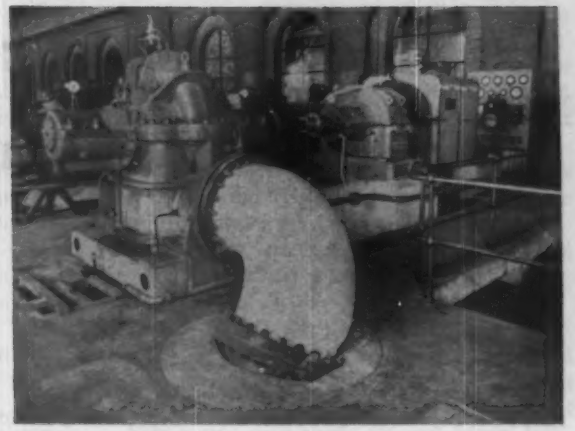

FIG. 5. OVERALL VIEW of turbine driven pump showing discharge connections.

ern end of the station, the connections to these are somewhat different. From each of the horizontal 24 in. delivery pipes from 7 and 8 pumps, an 18 in. vertical leg complete with a hydraulic gate valve will connect to a 24 in. pipe running southwards, parallel to the eastern wall of the station and below ground level. Units 10 and 16 will be connected to this main through an 18 in. horizontal cross-over pipe between their delivery pipes and then through a 18 in. vertical leg midway between the other delivery connections from these pumps. The Beecroft-Mobbs Hill main then continues southward turning through a quarter bend and passing through the engine room basement between the foundation for 13 unit and the roadway under the engine room, where it is reduced to 20 in. diameter. It then passes out through the western side of the engine room.

On the western side of the engine room and south of the boiler house, two new manifolds will be constructed, one for Beecroft and the other for the Mobbs Hill rising main. Into these manifolds will be connected the Beecroft-Mobbs Hill main from 7, 8, 10 and 16 units and the delivery pipes from 13, 14 and 15 units. Hydraulic gate valves will be installed at all connections.

With the new pipe connections Fig 6 the new pumping units will be able to operate under the best possible conditions at all times and the operation of the existing units will be more flexible.

Ash Handling

Manual removal of the ash from stokers has been superseded by a hydraulic ash sluice. The ash from all the boilers and the riddlings from boilers 3, 4, 10, 11, 12 and 13 and the economiser soot from boilers 12 and 13 drop into running water and are washed into a common trench. They then pass along the trench which runs the length of the ash tunnel under the engine room and into a pit located in the station yard 18 ft east of the engine room. There, the ash is lifted by an overhead travelling grab to a drying stack from which it is loaded into trucks for disposal. The water used to transport the ash is recirculated by an 8 in. pump driven by a 55 hp electric motor. The pump has a capacity of 1,600 gpm, which is sufficient for the needs of the sluicing system when all the boilers are in operation. An additional pump of similar capacity is provided as a stand-by.

To replace existing generators which supply station electric power and to provide for the additional power required by the auxiliaries for the new boilers and pumping plant, three 320 kw turbo-generators sets have been ordered. One will be installed between the present # 2 alternator and # 3 pumping unit and the other two will be installed in place of the two existing machines which have now reached the end of their useful life.

Costing an estimated £A1,027,000, the amplification work at the Ryde Pumping Station of the Metropolitan Water, Sewerage and Drainage Board Sydney, was scheduled for completion during the summer of 1959/60.

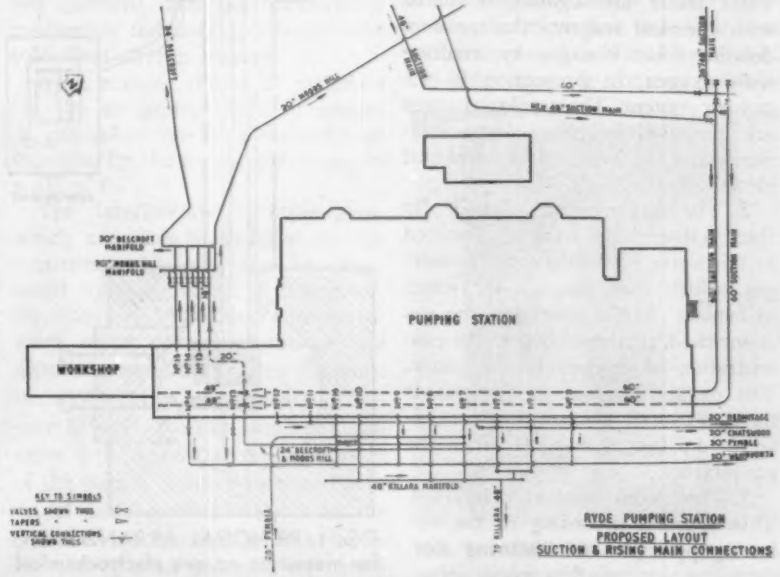

FIG. 6. PROPOSED LAYOUT of suction and discharge mains.

Continuous Measurement of Oxygen To Control and Regulate Aeration

By GEHARD STRACKE
Wuppertal, Germany

(Translated by C. E. Keefer, Sewerage Engineer, Bureau of Sewers, Baltimore, Md.)*

EDITOR'S NOTE: The Karl Imhoff prize was bestowed in recognition of this work at the annual meeting in 1958 of the Technical Sewage Association in Stuttgart.

■ THIS INVESTIGATION describes and compares several methods for the continuous measurement of dissolved oxygen. On the basis of this study, a continuous measuring apparatus was developed in the laboratory of the Emscher Association in Essen, Germany. The apparatus operates electrochemically and makes possible the determination of oxygen in very dirty water and wastes. It can also be used to regulate aeration in biological treatment plants.

The possibile methods for measuring dissolved oxygen, included in this study, are:

1. The colorimetric method. The water under investigation is mixed with chemical reagents that produce definite color changes by reacting with oxygen, in proportion to the oxygen content. These color changes are measured by photo-electric elements and are indicated or registered electrically.[1]

2. The displacement method. By this method[2,3] the oxygen dissolved in the water is displaced by an inert gas, which rises through the water in bubbles. At the same time the gas is enriched, corresponding to the concentration of oxygen in the water. The oxygen content in the gas is then measured electrically; for example, by the paramagnetism of the gas mixture.

3. The electrochemical method. This operates according to the following principle: a measuring electrode, which is in the water to be analyzed, is brought to a negative potential (about 1 volt compared with a calomel reference electrode). By this means, the oxygen which is dissolved in the water reacts at the surface of the measuring electrode, receiving electrons according to the empirical formula: $O_2 + 2H_2O + 2e^- = H_2O_2 + 2OH^-$. In the process, a zone poor in oxygen forms at the surface of the electrode while the concentration of oxygen remains practically unaffected in the fluid. Because of this oxygen concentration gradient between the solution and the surface of the electrode, a quantity of oxygen proportional to the concentration gradient diffuses to the surface of the electrode and reacts there by electron reception. The current is accordingly proportional to the concentration of the oxygen in the solution. The measuring electrode can be brought to a negative potential either by applying a voltage from without, or (according to Todt[4]) by placing it together with a base metal in the electrolyte, thus forming an electrochemical element. The current, as described above, is proportional to the oxygen content on the basis of the equivalent reaction on the measuring electrode.

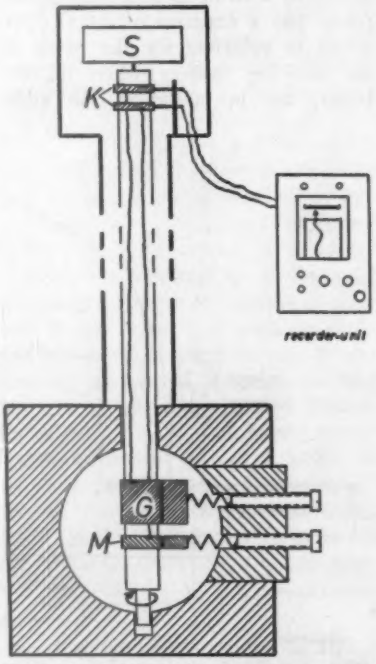

FIG. 1. PRINCIPAL ARRANGEMENT for measuring oxygen electrochemically by electrodes that are cleaned continuously.

Advantages and Disadvantages Of the Different Methods

The continuous measuring of oxygen is especially difficult in very dirty streams and in sewage. It is necessary to have apparatus which is not damaged by large objects or by intensely turbid water. The measurements must be made quickly so that the decrease in oxygen during the measuring process, which begins with the removal of the water, cannot take place; as errors due to this decrease cannot be gauged because the decrease is not constant but is a function of the B. O. D. and the chemical oxygen demand. The apparatus ought to be sturdy and able to withstand rough usage.

In connection with measurements in such liquids, as for example mixtures of sewage and activated sludge, the colorimetric method is adversely

*Coniributing Editor, WATER AND SEWAGE WORKS

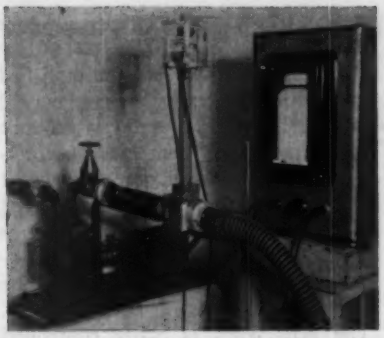

FIG. 2. MEASURING DEVICE in the earlier design for insertion in an aeration basin.

affected by turbidity and color of the water examined as well as by the pollution, which causes imperfect functioning of the dosing mechanism because of clogging of the magnet valve. The results are rendered incorrect because of loss of oxygen during the time of collecting the sample.

In connection with the displacement method, the long duration of the reaction, which is inevitable until equilibrium is reached between the gas phase and the liquid phase, further hinders the entry of little air bubbles from the water into the gas and the possibility of obstructing the passage of water and gas. Moreover, in both cases the retardation takes place in the supply pipes.

The difficulties with measuring by the electrochemical method were associated with dirtying of the electrodes, depositing of lime on the electrodes, changes in conductivity, fluctuations in temperature, and also on other disengaged ions near the measuring electrode.

Development of the Measuring Equipment

In connection with the investigation, it turned out that the electrochemical method created no fundamental difficulties for the described sphere of application in contrast to other methods. The defects of this method could be greatly eliminated, and therefore further investigations with it were carried out.

First of all polarimetric measurements were made with the dropping mercury electrode. An extraneous equal potential was constantly applied in opposition to a compensating calomel electrode. The measured results were satisfactorily regulated by measurements of short duration. However, by this means the constant maintenance of the velocity of the drops over a long period of time resulted in great difficulties. In the course of time the diaphragm of the calomel electrode became obstructed.

Thereupon an apparatus with fixed electrodes was developed. Figure 1 indicates the principle.

The apparatus works according to Todt's principle of oxygen measuring elements; that is, it dips into the water being tested two different noble metals, which are joined together across a microammeter. The nobler of these two metals forms the measuring electrode *M*, and the other forms the counter electrode *G*. Both of these electrodes are made in the form of cylinders and are rotated by a small synchron motor *S* close to polishers, which maintain the surface of the electrodes bright and clean by means of adjustable springs under pressure. By this means contamination of the electrodes and formation of layers of lime are avoided. The current to be measured is taken from the sliding contact *K*. Great freedom from interference of conducting changes is attained by the choice of the measuring resistances (2, 4).

The influence of temperature is compensated by a resistance which depends on temperature. This also dips into the water being measured and reduces the deflection of the microammeter by an equivalent amount with any increase in temperature. By this means the electric current measured increases with oxygen content, and the measuring mechanism indicates continually the equivalent oxygen content.

By a suitable choice of materials for the electrodes, different ranges of pH values can be measured; for example, by the use of zinc down to a pH of 6.

The interference of other ions, which are likewise reduced on the measuring electrode, can be eliminated by the method of difference; for example, by making a measurement under normal conditions and another measurement using the same water devoid of oxygen. The difference between the two measured currents depends on the oxygen content of the normal water. A second method of making measurements in the presence of interfering ions is by the use of other potential regulating processes. In general such interferences are rare. They appear only in special industrial wastes.

The electric current being measured is dependent on the velocity of the stream. With velocities over about 1 meter per second this current approaches a limiting value, so in this region changes in the velocity have only a very little influence. Accordingly, there must actually be at the electrodes a constant or a high velocity.

With such an apparatus, the oxygen content of flowing water as well as the mixed liquor in the aeration basis of an activated sludge plant was measured. At the same time, analyses by the Winkler method were made. The results given by the apparatus deviated in most cases not more than ± 10 per cent from the chemical analyses. In water that presents special difficulties, for example, in strong industrial wastes, the variations must at the present time be estimated to deviate by about ± 0.3 mg/L of oxygen when using direct measuring procedures.

The apparatus responds to changes in oxygen content practically without delay, which feature is very important for regulating and supervising operations. The continuous measuring of oxygen furnishes the possibility of regulating aeration according to the oxygen content along with fluctuations of the B. O. D. load. For biological activity in an aeration basin, it is sufficient to maintain the minimum oxygen content from about 1 to 2 mg/L. To make the measurements the apparatus was built first to be immersed in the effluent weir. By this means a constant velocity

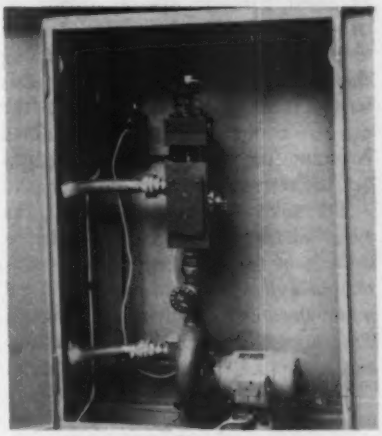

FIG. 3. MORE RECENT oxygen measuring device with electrode equipment and pump enclosed in sheet-steel box.

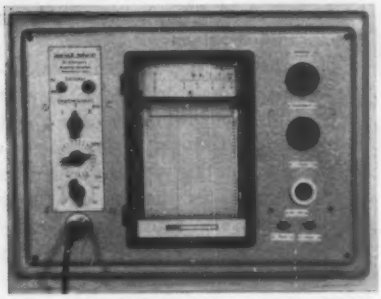

FIG. 4. RECORDING UNIT with maximum and minimum signals, designed to be connected with the electrode equipment.

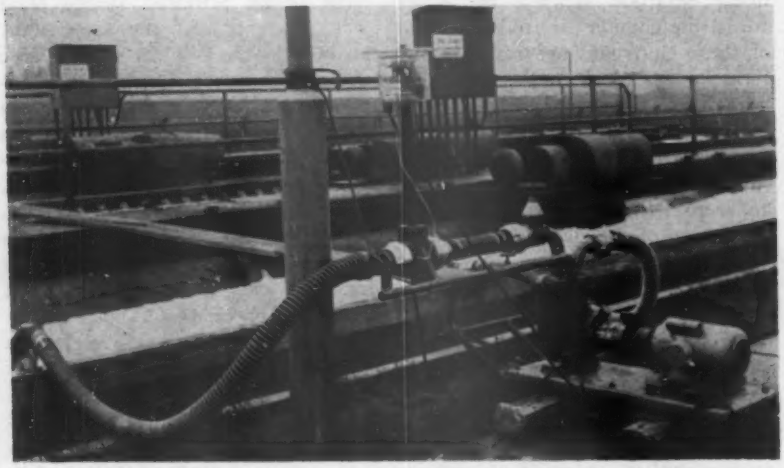

FIG. 5. CONTINUOUS measurement of oxygen in an aeration basin.

of flow, resulting from a constant difference in level, was guaranteed through the apparatus. For the regulation of an aeration basin, the oxygen content at the end of the basin (here the oxygen content diminishes by proper adjustment at peak loads only) is of less interest than from the beginning up to the middle of the basin. A still better efficiency is obtained through special regulation of each of the different aeration zones, which are distributed along the length of the basins. After this first zone of returned sludge, the oxygen content must be maintained constant from 1 to 2 mg/L throughout the remaining length of the basin.

To make these measurements the essential testing equipment, which is capable of transmitting a flow of water, is assembled with a centrifugal pump designed for use in a channel. The apparatus can be set in any suitable place in an aeration basin (Figure 2). The diameter of the piping and of the passages of the apparatus are purposely selected very large to make obstruction of the apparatus with strong sewage unlikely. Beyond the apparatus an exchangeable suction container with a double sieve can be connected in front of the suction pipe. The measurements are conducted to a measuring instrument with a recorder. A regulator can be connected to this to adjust the aeration automatically (Figures 3 and 4).

Figure 5 shows an apparatus in the tank of the activated-sludge plant at Detmold, where it was set up in October, 1957. The suction pipe with a suction strainer conveys a mixture of activated sludge and sewage from the first third of the whole aeration plant. In order to avoid loss of oxygen in the suction pipe, it is as short as possible (2 meters).

In conformity to results furnished by the apparatus, aeration is adjusted so the oxygen content in the aeration basin is maintained at about 2 mg/L, thereby obtaining considerable savings in the cost of electricity (Figure 6).

The measuring is accomplished with the waste water from the final settling basin. This water is brought into a measuring container at a definite oxygen content, for example at the saturation point, and is directed in a circular course through the apparatus. Corresponding to this oxygen content the sensitivity can be adjusted at the measuring instrument. The zero point is easily controlled either by a short interruption of the aeration in the aeration basin or following the breakdown of the mixture of activated sludge and water in the measuring container. This measuring container ought to be housed together with the measuring apparatus in a small enclosure, possibly near the aeration basin. The measuring instrument, possibly with the regulator, can be placed in the instrument room of the sewage plant.

At this point I should like to express my best thanks to Dr. Husmann, the director of the chemical department of the Emscher Association, for his friendly assistance and to Dr. von der Emde of the Institute for the Administration of the Sedimentation of Water in Hanover, which is under the direction of Professor Kehr, for mentioning the subject of automatic regulation.

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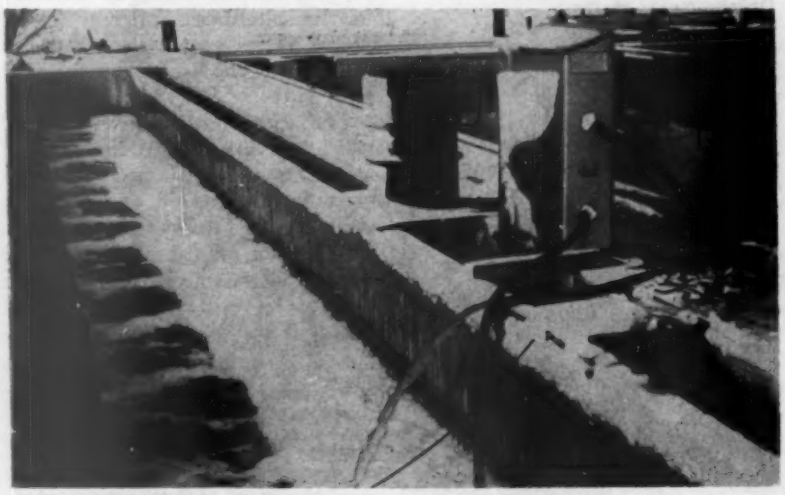


FIG. 6. ELECTRODE equipment with pump in action.

Excessive rinse requirements in a demineralizer plant were abated by . . .

Ammonia Regeneration of weak base anion resin

by S. B. APPLEBAUM and F. FAST,
Cochrane Corp., Phila., Pa. and Mobil Oil Co., Paulsboro, N. J. respectively.

EDITOR'S NOTE: This article is a formal discussion of the paper "Five Years Weak Base Anion Resin Experiences on the Ohio River" by J. K. Sargent, Jones & Laughlin Steel Corp., and G. A. Bowman, Dravo Corp. This material was originally presented at the 20th Annual Water Conference, Oct. 1959 and is published here with the permission of the Engineer's Society of Western Pennsylvania.

The experiences of operating a fifteen year old cation and anion exchange resin demineralizing plant producing up to 1800 gpm of treated water for chemical process purposes is reported. The anion resin used has always presented some problem; however, the discussion is centered on the regeneration of polystyrene anion resin during the past five years. First soda ash was employed, then caustic soda, and finally ammonia hydroxide. The use of ammonia hydroxide cut regenerant costs about 16 per cent and saved about 70 per cent of rinse water previously wasted during caustic soda regeneration.

■ THE DEMINERALIZER PLANT at the Paulsboro Refinery of Mobil Oil Company is a large wood gravity plant installed about fifteen years ago, during World War II, when rubber lined steel was difficult to obtain. It now includes seven cation units and six anion units, each 9 ft in diameter by 20 ft high, designed to treat up to 1800 gpm of water for chemical process purposes. Coagulated and filtered Delaware River water is the main water supply with an average sulphate plus chloride content of 50 to 100 mg/l (as $CaCO_3$).

The plant has been described previously.[1] The discussion deals with the anion resin operating experiences plant and principally the recent change to ammonia as a regenerant to solve the problem of excessive rinse requirements.

Anion Resin Used

The weakly basic anion resin used at this plant has always presented some operating problems. Various types of resin have been used over the years. First, an early variety of phenolic—polyamine type, was used. This dropped in capacity quite rapidly and after a few years was replaced by a later phenolic type which lasted longer.

Then a polystyrene—polyamine resin became available and was selected to replace the phenolic resin. This resin has proved to be the most stable of the three types used. However, a problem of rinse requirements for regeneration of this resin became apparent.

Excess Rinse Requirements

Soda ash was first used as the regenerant. Later, caustic soda was adopted because it increased the resin capacity. This was attributed to the fact that free CO_2 collected in the anion resin bed in these gravity units when soda ash was used. Caustic soda avoided this. Also, caustic soda kept the resin cleaner than soda ash. However, after this polystyrene resin aged about two years, the volume of water and the time required to rinse the caustic soda to the sewer became excessive.

The polystyrene anion resin beds were installed in 1954 in two units and in 1955 in the other units. From January 1, 1955 to August 30, 1959 the six anion units treated a total of about 3,000,000,000 gallons. Since the total volume of anion resin in the six units is 2040 cu. ft., the resin has treated about 1,500,000 gallons per cubic foot. The capacity initially was about 25 kilograins of total mineral acidity (as $CaCO_3$) per cu. ft., of resin and today, about 4 to 5 years later, it is about 15 kgrs./cu. ft. If it were not for the excessive rinse problem, this would be an excellent anion resin performance.

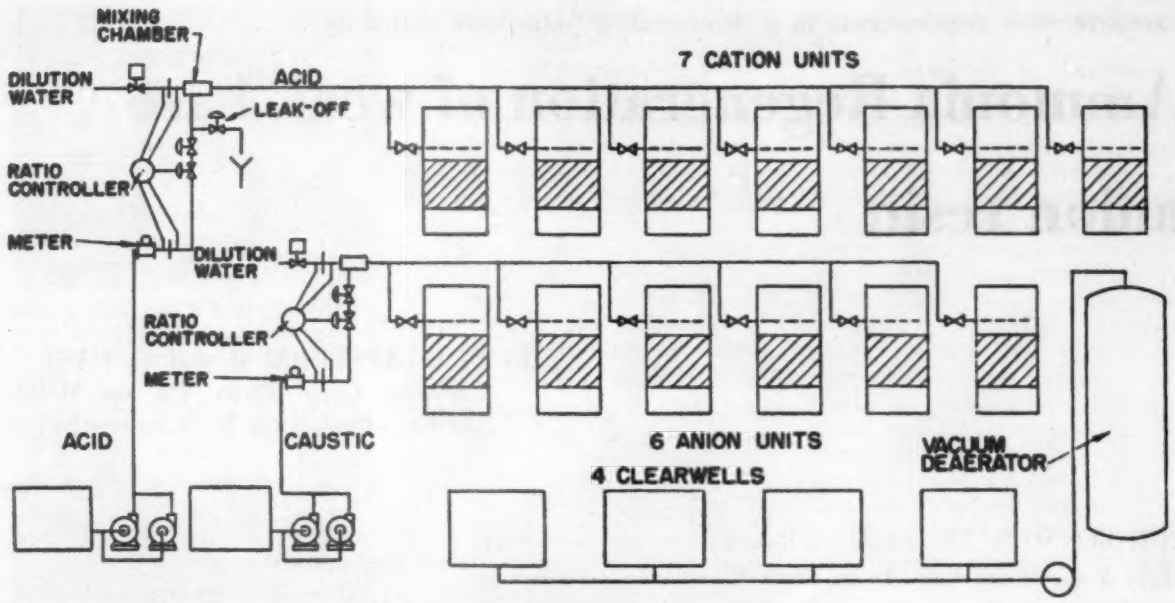


FIG. 1. GENERAL FLOW DIAGRAM for Mobil Oil Co. gravity demineralizer.

The schedule for rinsing the regenerant from the resin beds consists of three steps:

1. Slow rinse or displacement at 100 to 120 gpm for 10 to 15 minutes.
2. Fast rinse at 380 gpm wasted to the sewer until the total dissolved solids (measured by conconductivity and expressed in terms of $CaCO_3$) drops to about 50 to 90 mg/l.
3. Fast rinse recycled by pump at 380 gpm back to the cation inlet, until the total dissolved solids drop to about 10 to 12 mg/l, at which time, the unit is returned to service.

Table 1 shows the rinsing required with caustic soda regeneration at low water temperatures when the resin was new and after it was over four years old (early in 1959). The rinse time more than doubled and the rinse volume more than tripled in that period. Actually, the total rinse time required with the aged resin ranged from about 6 to 8 hours and the water wasted from about 200 to 400 gallons per cu. ft., of resin, depending on the water temperature. The effect of low water temperatures is quite pronounced in prolonging the rinsing. Table 2 shows the relation between gallons wasted and the water temperature in the range of 40 to 60 F., as observed early in 1958, with caustic soda regenerations.

Ammonia Regeneration

Ammonium hydroxide, a weaker alkali than caustic soda, is known to be capable of regenerating weakly basic anion resin. It cannot be used to regenerate strongly basic anion resin and, therefore, cannot be used for three bed systems, where caustic soda is passed counter-currently through the strong and weak base anion resins to save regenerant. However, for this two bed system, it was quite feasible. It was tried in the Cochrane laboratory on the aged resin and found to reduce the rinse volume and time required very drastically. Apparently, the NH_4 ion is not absorbed and held so tightly by the exchange groups formed by aging of the polystyrene anion resin. It was, therefore, suggested for large scale use at Paulsboro.

Before adopting it, however, three possible adverse effects, which the ammonia might cause, were studied. These were:

1. Creation of objectionable ammonia odors. Since the measuring tank to be filled with the ammonia was covered, it was felt that the odors from that source would be prevented. In addition, an open sump received the rinse water. However, the amount of ammonia present in the rinse water as determined in the laboratory studies was considered to be too low to create an objectionable odor. This proved to be true after the ammonia regenerations were put

Table 1
Average Rinse Schedule
With NaOH Regeneration

	New Resin		Over 4 Year Old Aged Resin	
	Time Minutes	Total Gallons	Time Minutes	Total Gallons
Slow Rinse at 150 gpm	10	1,500	10	1,500
Fast Rinse Wasted at 380 gpm	90	30,000	300	115,000
Fast Rinse Recycled at 380 gpm	70		78	
Total Time	170		388	
Total Gallons Wasted		35,500		116,500
Gallons wasted per 340 cu. ft. of resin		105		342

Table 2
Approx. Rinse Volume vs. Temperature of Water (Using NaOH Regenerant)

Temperature ° F.	Gal. of rinse wasted per cu ft of resin
40	350 to 400
50	300 to 350
60	200 to 250

into use. The only trouble from odor experienced was during the first regeneration when the ammonia pump was primed and strong liquid ammonia entered the open sump. This, of course, was not repeated after that occurrence.

2. Corrosion of brass and copper parts in the water or steam cycle by ammonia present in the demineralized water. Laboratory tests indicated that the amount of ammonia to be expected would be about 0.5 mg/l on the average and too low to cause corrosion troubles. This conclusion was also supported by the fact that ammonia had been added to the demineralized water in the past to raise the pH. The amount of ammonia present after such addition was also about 0.5 mg/l on the average. No trouble from corrosion had been experienced. Furthermore, others who add ammonia as a corrosion inhibitor, as in Central Power Plants, also raise the amount of ammonia in solution to about 0.5 to 1 mg/l without reported corrosion.

3. Difficulty of disposal of rinse water to the sewer due to presence of ammonia and ammonium sulfate and chloride in the rinse water. This was not anticipated to present any problem at Paulsboro because the rinse water would enter a holding basin which receives large flows of other waste water. These other streams would dilute the ammonia and ammonium compounds in the combined or blended waste to reasonable limits.

Table 4
Character of Treated Water With Ammonia Regeneration

	At Start of Run	Middle of Run	End of Run
pH Value	6.8	5.5	4.3
T.D.S. in ppm (as $CaCO_3$)	10 to 12	2 to 3	10 to 12
Ammonia Salts in ppm (as NH_3)	1 to 2	0.3 to 0.4	zero

Large Scale Ammonia Regeneration

On the strength of the laboratory findings, it was decided to try the ammonia on a large scale. The first ammonia regeneration was carried out in March, 1959. It was so successful that it has been continued in use ever since. When this first regeneration took place, the river temperature was still quite low, being 50 F. Therefore, the reduction in rinse water requirements experienced compared to the last caustic soda regeneration with the same aged resin and with the same low water temperature was quite dramatic.

Table 3 shows this rinse schedule with the ammonia. During a five month period the water wasted ranged from 85 to 100 gallons per cu. ft., and the total time required ranged from 160 to 180 minutes. Compare these results with Table 1 (right hand column) which shows the rinse volume and time required with the caustic soda at about the same water temperature. The use of ammonia regenerant on the aged resin reduced the rinsing time and volume to that required with new resin when caustic soda was the regenerant.

Table 4 shows the character of the treated water at start, middle and end of run with ammonia regeneration. This indicates that the amount of ammonium salts present were under about 0.5 mg/l, expressed as NH_3, which confirmed the laboratory studies.

The use of ammonia has not changed the capacity of the resin which has remained at about 15 kilograins of acidity (expressed as $CaCO_3$) per cubic foot of resin.

Regeneration Facilities

Figure 1, shows the general flow diagram of the Demineralizer. The liquid caustic soda previously used was stored in a large storage tank at ground level. The tank served both this gravity Demineralizer containing weakly basic anion resin and a pressure Demineralizer (for high pressure boilers) containing strongly basic anion resin. From this caustic storage tank, a 50 per cent NaOH solution was pumped to the measuring tank inside the Demineralizer plant shown on the diagram.

When liquid ammonium hydroxide was adopted, the ground storage tank still had to be retained for the pressure Demineralizer. Therefore, temporarily, a tank car was kept on an idle spur nearby to serve for ammonia storage until a new large tank was constructed. Trailer trucks of ammonia were delivered alongside and discharged into this tank car. It is pumped from the tank car to the measuring tank when needed. The ammonia handling facilities do not differ in design from the caustic soda equipment previously used.

Table 3
Typical Anion Rinse Schedule With Ammonia at 50°F. Water Temperature

Step	gpm	Minutes	Total Gal.
Slow Rinse	100	15	1,500
Fast Rinse Wasted to Sewer	380	79	30,000
Fast Rinse Recycled	380	75	
Total		169	31,500 gals. wasted

$$\frac{31{,}500 \text{ gallons}}{340 \text{ cu. ft.}} = 93 \text{ gals./cu. ft.}$$

Savings Using Ammonia

The savings in regenerant cost, as well as the value of the wasted water, have been quite pronounced. In calculating the value of the wasted water, it was first necessary to determine the cost of producing the chlorinated, coagulated and filtered water. Since the anion rinse water must first pass through the cation unit, using up some of the cation exchanger capacity, the cost of producing cation effluent by evaluating the

Table 5
Savings By Ammonia As Regenerant Compared to Caustic Soda

Cost of a NaOH Regeneration (March, 1959)	
923 lbs. of 100% NaOH @ c3.3	= $30.50
115 M gals. rinse wasted @ c 5.00	= 5.75
Total	$36.25
Cost of an Ammonia Regeneration (March, 1959)	
500 lbs. of 100% NH_3 @ c 5.1	= $25.60
31.5 M gals. rinse wasted @ c 5.00	= 1.57
Total	$27.17
Saving per unit regeneration	= $ 9.08

From April 1 to August 30, 1959, there were 56 unit regenerations. In a year, at the same rate, there would be 672 unit regenerations
$6100 saver per year

acid used in regeneration must also be included. The plant records indicate a total cost of $0.05 per 1000 gallons rinse water for both the coagulation and the acid.

Table 5 shows the estimated annual saving which ammonia regeneration will effect (compared to caustic soda and aged resin) based on current costs of regenerants and the calculated value for rinse water. It is assumed that the total number of unit regenerations will continue for the rest of the year at the same rate as in the first five months with ammonia regenerations. These calculations show an annual saving of $6100 in favor of ammonia.

Conclusion

Polystyrene—polyamine weakly basic anion resin at Paulsboro suffered from excessive rinse requirements when using caustic soda regeneration of resin which had aged several years. These requirements were especially apparent during winter cold water temperatures. Otherwise, the resin showed good stability and life expectancy.

The adoption of ammonia as the regenerant solved the problem of excess rinse requirements. Compared to caustic soda, the ammonia reduced the rinse time in half on the aged resin at cold water temperatures. In addition, the ammonia cut regenerant costs about 16 per cent and saved about 70 per cent of the rinse water previously wasted. These savings, supplementing the solution of the excessive rinse problem, have made the use of ammonia quite favorable as the regenerant at Paulsboro.

Reference

Sprigman, C. J.—"Effect of Drought Delaware River Water Conditions on Demineralizing Plant Operations"—Proc. 15 Annual Water Conf., Engr. Soc. W. Pa., 1954—p. 123.

BOOK REVIEW

The second English edition of a handy little reference book* is now available by mail order from Hugh K. Elliott, Ltd., P. O. Box 284, 199 Piccadilly, London, W. 1, England. Containing 14 chapters, Degremont's handbook contains a little bit about a lot of things interesting to waterworks men.

Some of Degrement's latest installations are described and illustrated, revealing types of equipment not generally seen in the U. S. Six colorimetric and twenty-one volumetric analytical methods are included in a second entitled The Chemistry of Water. The usual conversion tables are included, together with an excellent section on mathematical notes.

The second English edition has been expanded ninety-four pages including for the first time, among other things, water treatment recommendations of the World Health Organization.

*Water Treatment Handbook, Degremont ACFI S. A., Surenes (Seine), France, 1960, ($8.40 plus $0.20 postage).

Arizona Establishes Comitttee to Study Water Resources

A State water resources study committee has been established by Arizona's Governor Fannin since a U. S. Supreme Court master has held that the state is entitled to a full 2,800,000 acre-feet of mainstream Colorado River water annually. This preliminary finding is yet to be affirmed by the high court.

The governor said that the committee's primary purpose is to consider and recommend legislation necessary to create the proper agency or agencies which would have authority to contract with the Secretary of the Interior for water delivery to the various areas of the state now suffering from inadequate water supply. The committee will also study ways to conserve the state's present water resources.

U. S. Concrete Pipe Elects McGarry

United States Concrete Pipe Co., subsidiary of Pittsburgh Coke & Chemical Co., recently announced that William R. McGarry has been elected a vice president. Mr. McGarry began his career in the vitrified clay pipe industry in 1935 and remained in the production end until 1949 when he entered the sales field, handling both concrete and vitrified products.

In 1956 when the company extended its operations to the Florida market he was named manager of U. S. Concrete Pipe Company's Ft. Lauderdale plant.

Pakistan Engineer Studies MSD Methods

Some of the methods and operational functions of the Metropolitan St. Louis Sewer District will be applied to the operations of sewage treatment facilities in Pakistan. This was made possible by a training visit with the District by an engineer of the Karachi Development Authority.

Muzzaffar Ahamed Mirza, Assistant Engineer of the Karachi Authority, is spending a year in the United States on a technical exchange basis program sponsored by the United States Public Health Service and the Government of Pakistan.

Colorado's Reservoirs Ok'd For Recreational Use

Denver's board of Water Commissioners have approved a proposal for boating, hunting and fishing activities at Williams Fork, Antero and Eleven Mile reservoirs.

The City agency approved a contract with the State Department of Natural Resources permitting the recreational uses, subject to further negotiation with the State Fish and Game Department, a branch of the State Natural Resources Department. For quite some time, the City board and the Fish and Game Department have disagreed about the reservoirs and stream fishing.

State Natural Resources Director Edward L. Clark lauded the contract under which his department will regulate recreation and collect revenues for boating and other activities.

If you want to know how rich you really are, figure out what you'd have left if you lost all your money.

Partially Oriented on . . . . .

A Stirring Event

I see that a recent convention of the American Water Works Association held a "Mixing of the Waters" ceremony. "Representatives of fifty states and four foreign nations mixed waters from their home states or country in the pool," says the roving reporter of this reliable journal; "thus illustrating the increasing international awareness of the vital role played by water in the advancement of civilisation." "The ceremony of mixing," adds the reporter, "came to a climax when Miss Jackie Johnson, of Miami, Fla., was crowned 'Miss American Water Works Association' "

A shadow of despondency fell upon my spirits as I read this passage. The question, as I see it, is—Will the British Ever Make It? Has the British Institution of Water Engineers had it, or not? Are the advancing techniques of our American cousins so far ahead of us now that there is not a hope of catching them up.

Fortunately, the roving eye of the reliable reporter enabled him to take a photograph of the ceremony just at the crucial moment of the crowning of Miss A.W.W.A., and I have been able to examine it with minute care to see what chances we have in Britain of conjuring up a similar ceremony. I foresee difficulties, but not necessarily insuperable ones.

The first difficulty that strikes me about the American convention is that all the participants are exhibiting an entirely un-English amount of glee. There isn't a solemn dog among them. High up in the air, on the end of the springboard overlooking the pool, the Chairman is in the act of crowning Miss A.W.W.A., and fifty-five gleeful male faces look on. Even the man standing closest to the deep end of the pool (9′ 0″) doesn't seem to have a care in the world, and, as for the groups standing shoulder to shoulder along the diving board, not one of them looks as if he is bothered about the $\Sigma(w_1l_1 + w_2l_2 + \ldots)$ bending moments being created on the cantilever arm supporting him.

Of course nobody is more experienced in the making of successful conventions than the Americans. Something tells me that the presence of one woman (and that a beauty queen) in the company of fifty-five men is not just chance, but a highly organised event cleverly planned by men who have had years of experience of men. I cannot quite judge for myself the success they have achieved because the Chairman, who is crowning the queen, has momentarily raised his arm in front of her face—"Would you mind, Sir? Only just for a moment—ah! Very nice—thank you."

And then, of course, the Americans have, with their usual efficiency, arranged for the sun to shine on the scene. Did I say shine? That is too lack-lustre a word. This American-efficient sunshine positively bounces off every polished surface and irradiates every corner with incandescent brilliance. Alas—an engineer's vocabulary cannot do justice to the scene.

And how now about the English possibilities? Let us not succumb to despair straight away but face, first of all, the major difficulties.

To start with perhaps we had better set up a Research Committee to find out whether it would be safe to have a free-for-all mixing of English waterworks waters. You never know, one or two authorities are still a bit touchy and we haven't yet created Utopia in waterworksland over here; so, perhaps we should go carefully at first and avoid risk of starting off an explosion by mixing minute quantities of the waters one by one in the laboratory first. No doubt our chemists could produce a non-explosive order of mixing if we give them a little time.

We might need another committee of experts to avoid chemical and odour troubles arising too; and there are one or two dicy waters rather subject to "after precipitation" which might need careful handling. We shan't want to plug the pool outlet hole up by too precipitous a precipitation! And then there are one or two other authorities who will be in a spot of trouble because of water so hard that it won't pour at all. Perhaps it would be better to have them take symbolic part in the proceedings rather than have them grind their water into the pool.

Then, of course, we shall need a Quantity Panel, to draft regulations about the quantities of water to be mixed, each to each. We cannot have a little parish council's jam jar full being swamped by a thousand gallon tanker towed up by one of these big publicity-minded authorities. No sirs, even the meanest most manganese-ridden, over-chlorinated drinking fluid should be as welcome as the purest treatment plant effluent. We must rid our hearts of snobbery on an occasion like this.

Likewise, we must rid our minds of woeful thoughts. An *ad hoc* Committee, appointed by the Chairman of the I.W.E., could be charged with the express duty of getting jollification measures going at the meeting. Special Jollification Men could be appointed to go around the gathering and pick out all the long-faced water engineers to tell them funny stories about other water engineers in worse troubles than they. If this didn't work, a panel of psychiatrists could interview these woeful engineers in a private room at the back of the meeting and give helpful advice. (Sample: Quit the profession. Second sample: Never mind, here's safety pin to keep them up.) After an hour or two's work by the Jollification Men (and the drink) everyone ought to be in a proper atmosphere for the crowning of "Miss I.W.E."

I think that just about covers everything. About the weather? Goodness, why worry about that! Everybody can bring a raincoat and umbrella and galoshes and waders and oilskins can't they? What water engineer is ever depressed by the weather!

PROGRESS RESEARCH REPORT

Continuous Gas Analysis may provide better control through . . .

Application of Gas Chromatography to Sludge Digestion Gas Analysis

by WERNER N. GRUNE, Project Director
Prof. of San. Engrg.
School of Civil Engineering
Georgia Institute of Technology
Atlanta, Georgia

RESUME: The search for practical and efficient means to operate digestors continues. This report summarizes eighteen month's devoted to studying partition columns, various partition materials, hydrogen, argon and hydrogen sulfide. Work has been performed under National Institutes of Health Research Grant RG-4945.

The Problem

■ THE CONCENTRATIONS of specific components in sludge digestion gas, such as methane, carbon dioxide, hydrogen sulfide and ammonia, to further basic knowledge of the mechanism of the anaerobic process, have been the subject of many intensive reasearch investigations. The lack of a simple and reliable method for gas analysis has prevented the establishment of precise relationships to support experimental evidence and theory.

Although considerable information has been collected about the composition of gases from digestion, organized research in this area has been difficult and the available data only fragmentary. This research project has been designed to establish the composition of digester gas mixtures from domestic sludges and those containing toxic wastes. It would be useful to follow the course of digestion by complete gas analysis indicating the changes in gas quality with progress of digestion. Such analysis could test several hypotheses, such as the role of hydrogen sulfide during anaerobic digestion, the path of methane fermentation to distinguish between acid cleavage and carbon dioxide reduction to methane by feeding C-14 labelled compounds, and the significance of specific gas components in the mixture.

Purpose of the Study

The purpose of the study is to develop a simple but accurate chromatographic method for the qualitative and quantitative analysis of the gases from decomposition during sludge digestion. The general method of gas chromatography shows real promise as a precise, analytical tool for sanitary scientists. It is expected that with this new technique gas production from anaerobic digestion can be placed on a more rational basis, will improve the fundamental understanding of the mechanism of anaerobiosis and aid in the solution of digester problems.

Another aspect of the study has been to develop a method to accurately determine gas quality and quantity on a continuous basis. With the aid of such a system this method of analysis will also become available to the smaller plants with limited laboratory facilities and trained personnel. Gas chromatography, beyond a gas analyzer, may also provide operational control for the sludge digestion process.

This newly developed technique for sludge gas analysis would: (1) provide treatment plant operators with the information to adjust the daily feed for optimum digestion in accordance with the quality of the gas produced (by means of a simple reading); (2) point the way toward optimum digester operation for maximum methane production (with a minimum of noxious or corrosive gases), and; (3) place into the hands of research workers in the sanitary science and other fields, where fermentation studies are needed, an extremely useful new tool.

Summary of experimental results

Silicone Grease Column for Routine Analysis

A silicone grease partition column, recommended as an optimum column in a previous progress report (1), has replaced the silica gel adsorption column for routine daily analysis. The 71 ft column provides fine separation between air and methane, and complete separation between methane and carbon dioxide, and carbon dioxide and hydrogen sulfide. The column is packed with silicone grease (*) coated firebrick particles of 28 to 48 mesh, with a liquid to solid ratio of 60:100 (by weight) for the first 35 ft, and 35:100 (by weight) for the remaining 30 ft. Compared to the solid adsorption columns previously used, the gas-liquid partition column provides sharper peaks, especially for

carbon dioxide, shorter analysis time, is less affected by water vapor and shows longer service life. The present column has been under continuous service for over one year to analyze at least 20 samples each day and still performs satisfactorily. Excellent reproducibility of better than one per cent has been achieved.

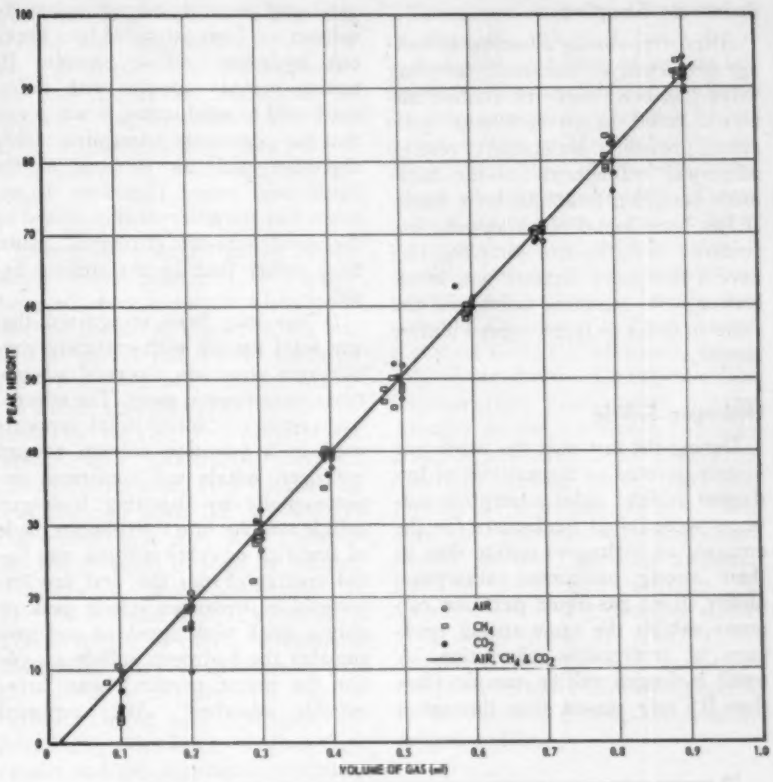
Another special feature of the column is that it produces equal peak heights for the same amount (by volume) of air, CH_4 or CO_2, as shown in Figure 1. This obviates the need for the type of calibration curves which were needed previously, as seen in Figure 2.

Other partition liquids

Organic solvents, other than silicone grease, have been studied for use as coating materials. Their absolute retention volumes, corrected for the pressure drop across the column, expressed as ml per gm of partition liquid, are summarized in Table I below. These retention volumes, which are directly related to the free energy of separation, have been determined experimentally and confirm the theories of Martin and Synge (2) and Martin and James (3), that they are a function of the characteristics of the binary system of gas and fixed liquid phase and the column temperature. Further studies of the limitations of the limitations of these theories and necessary modifications are under way.

It is apparent that silicone grease, silicone oil 550, and tetra-isobutylene have comparable resolving abilities for air, methane, carbon dioxide and hydrogen sulfide, the major components present in sludge gas. Liquid coatings with tetra-isobutylene have been found to produce a slight separation between oxygen and nitrogen.

(*) Dow Corning Stopcock Grease, manufactured by the Dow Corning Corp., Midland, Michigan.



CALIBRATION CURVES FOR AIR, CH_4 AND CO_2

COLUMN: 71 FT. SILICONE GREASE, C-22, 28-48 MESH
FLOW RATE: 102 mls/min.
COLUMN TEMPERATURE: 80°F

FIGURE 1

However, such separation is not sufficient for analytical purposes but introduces the difficulty of interpreting the air peak which varies not only as the quantity but also as the quality of air (N_2 : O_2 ratio) present.

Dimethyl sulfolane possesses a strong resolving ability for carbon dioxide, however it is weak in separating methane from air. Columns coated with tricresyl-phosphate were found to be relatively weak in resolving methane and carbon dioxide. This effect may be due to the polar characteristics of the organic coating liquid which may also be the reason for the column to exhibit a weaker permanent adsorption tendency toward hydrogen sulfide than with other liquid coatings.

Detection of Hydrogen and Argon

Molecular sieve (type 5A) columns combined with a sensitive recorder (0 to 1 mv range) have been used to detect concentrations of hydrogen as low as 16 p.p.m. However, no hydrogen has been found thus far in the sludge gas produced from laboratory digesters. A more systematic and intensified investigation to detect the presence of hydrogen will be initiated shortly. Considerable argon has been found along with nitrogen. These findings tend to confirm the assumption that nitrogen present in sludge gas is introduced from the atmosphere rather than produced during the anaerobic decomposition of sewage sludge.

TABLE I

Experimentally Determined Retention Volumes for Several Organic Partition Liquids

Column Material		Silicone grease	Tri-iso butylene	Tetra-iso butylene	Tri-cresyl-phosphate	Dimenthyl sulfolane	Silicone oil 550
Column Temp.		73°F	70°F	75°F	80°F	73°F	77°F
Retention Volume (ml/gm)	CH_4	0.336	0(**)	0.35	0(**)	0.074	0.206
	CO_2	1.13	0.215	1.34	0.484	3.33	1.18
	H_2S	5.00	—	5.10	3.77	—	6.05

(**) No separation between air and methane

Automatic Sampling

After overcoming a number of leakage problems, an automatic sampling valve has been used for routine analysis. Based on ten months of operation, providing satisfactory results, additional refinements of the automatic sampling technique were made. It has been found of paramount importance that the gas sampling line have a minimum distance and bends between the sampling point and the valve in order to inject representative samples.

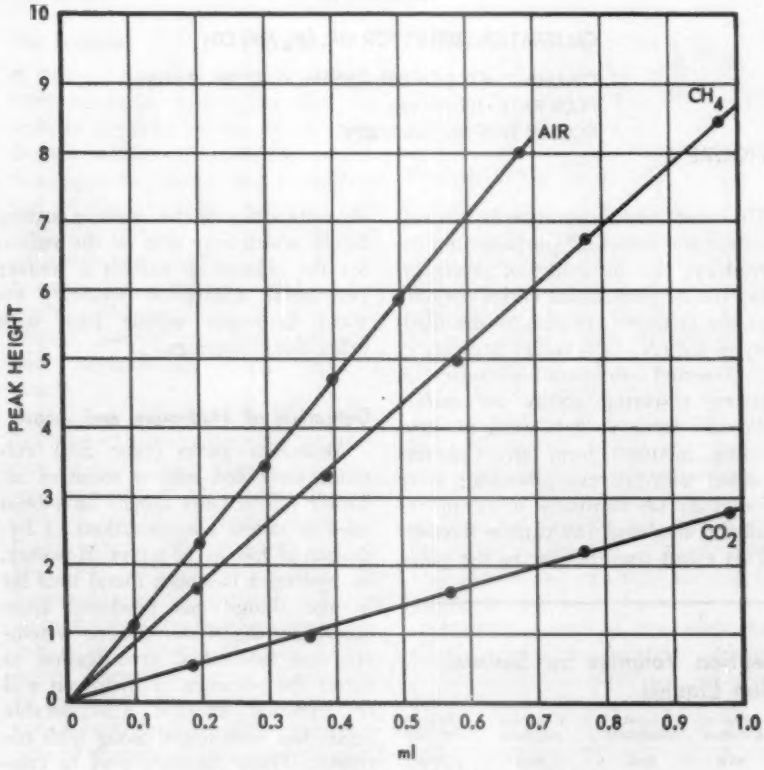
Hydrogen Sulfide

During the last year the work was largely devoted to the analysis of hydrogen sulfide. Solid adsorption columns were found inadequate for the analysis of hydrogen sulfide due to their strong permanent absorption ability. Even gas-liquid partition columns exhibit the same strong tendency of irreversible adsorption. A small hydrogen sulfide sample (less than 0.5 ml) cannot pass through a gas-liquid partition column unless the column has been saturated by a previous hydrogen sulfide sample. By testing various samples with different liquid to solid ratios, it was found that the permanent adsorption ability decreases with an increase of the liquid-solid ratio. Therefore, it appears that the adsorption is caused by the solid support (firebrick, celite, etc.) rather than by the coating liquid.

It has long been recognized that any solid surface with sufficient contact area possesses a certain adsorption power toward gases. The adsorptive power of "inert" solid supports used in a partition column toward hydrogen sulfide was confirmed experimentally by injecting hydrogen sulfide samples into the columns made of firebrick or celite without any liquid coating. From the first few injections no hydrogen sulfide peak or only a small peak appeared and presumably the hydrogen sulfide sample (or the major portion) was "irreversibly adsorbed". After repeated injections the peaks grew larger and then maintained a constant height, indicating that the column had become saturated with hydrogen sulfide. However, the saturated condition was found to be permanent but the column soon became unsaturated again due to the purging action of the carrier gas.

Uncoated firebrick columns also provided good resolution between air and hydrogen sulfide although such resolution must have been caused by the adsorption on the firebrick surface. The adsorption in the latter case may be termed as "reversible adsorption" and should not be confused with the "irreversible adsorption" mentioned previously. The adsorption of carbon dioxide by silica gel at room temperature is reversible because the adsorbed carbon dioxide may be purged back into the gaseous phase by the carrier gas. However, the adsorption of carbon dioxide by molecular sieves is "irreversible" because no carbon dioxide can be recovered by purging the molecular sieve column with helium at room temperature. It is rather difficult to understand that firebrick would possess both adsorption characteristics. This phenomenon may be explained by the presence of sites with varying energies of adsorption on the surface of the firebrick, as has been assumed by White and Cowan (4). Both types of adsorption phenomena of solid supports are undesirable for preparing an efficient partition column, but the "irreversible adsorption" is the main object of attack of the present investigations because it makes the analysis of low concentrations of hydrogen sulfide impossible. Comparing the amount of hydrogen sulfide required to saturate various columns of similar length, it is found that the celite-545 column has a stronger "irreversible adsorption" ability than the C-22 firebrick, although the former does not resolve air and hydrogen sulfide which means that it has a weaker "reversible adsorption" ability than the firebrick.

Various methods of deactivation of firebrick and celite have been investigated. They can be classified as: (a) washing with an alkali solution, such as diluted NaOH; (b) washing with an inorganic acid, such as concentrated or diluted HCl; (c) precoating with an organic compound, such as stearic acid, oleic acid or glycerine;



CALIBRATION CURVES FOR AIR, CH_4 AND CO_2

COLUMN: 12 FT. SILICA GEL, 28 – 48 MESH
FLOW RATE: 80 mls/min.
COLUMN TEMPERATURE: 130°F

FIGURE 2

or (d) mixing the organic compound with the coating liquid such as silicone fluid 550 or triethylene glycol. In some cases a combination of the above methods were employed.

Over 30 columns have been prepared for this particular investigation of the adsorption of hydrogen sulfide. These columns were studied by repeatedly injecting hydrogen sulfide samples of 1,000 p.p.m. in 2 ml of air. Both the amount of sample required to saturate a column before the first hydrogen sulfide peak appears and its height have been used as a basis for the comparison of the irreversible adsorption phenomenon. Two different temperature levels 80° F and 200° F, have been examined along with various flow rates. From the results obtained thus far the following conclusions may be drawn:

(1) Although the "reversible adsorption" of the solid support material is generally weaker (lower resolution power) at high temperatures, the "irreversible adsorption" does not seem to be similarly affected by the temperature. Hydrogen sulfide is adsorbed by firebrick or celite at 200° F as well as at room temperature.

(2) The flow rate exerts no significant effect.

(3) An increase in the pH value of firebrick appears to aid absorption; however, maintaining a pH on the acid side only slightly reduces the normal adsorptivity of the solid support.

(4) The best results have been obtained by the following treatment procedure: To a suspension of 200 gm of the fine meshed C-22 firebrick in 500 ml distilled water add 20 ml of 0.1 N NaOH aq. solution to bring the pH to a value of 10.5. Discard the solution and wash the firebrick with distilled water until its pH reaches a value of 7.3. Dry the firebrick in an oven at 600° F for one hour. Precoat the firebrick with stearic acid (3% by weight of firebrick) before coating with a partition liquid, such as silicone fluid 550.

In an experimental run, 1,000 p.p.m. hydrogen sulfide in a 2 ml air sample appeared after the first injection, although the peak height was low (0.3 unit as compared to 8.0 units peak height obtained after the column was saturated), indicating that a great portion of hydrogen sulfide was irreversibly adsorbed. No significant improvements have thus far been shown by any other method of treatment of solid support materials.

During more recent studies results which may represent a "breakthrough" were obtained when polyethylene instead of copper tubing was used to pack liquid coated particles. The irreversible adsorption of hydrogen sulfide appears to have been eliminated by packing the polyethylene tubing with pretreated firebrick (washed with conc. HCl followed by neutralization with 0.5 N NaOH) and coated with oleic acid (ratio of 2 : 100 of liquid to solid by weight) and silicone fluid 550 (ratio of 50 : 100 of liquid to solid by weight). Therefore, the so called "irreversible adsorption" may be at least in part attributable to the chemical reaction between copper and hydrogen sulfide. Further studies to confirm these results and the postulated conclusion are under way.

In addition to any reaction with copper; hydrogen sulfire may also be catalytically decomposed. As stated by Barry (5) most of the commonly used solid adsorbents will catalytically convert hydrogen sulfide to free sulfur in the presence of a trace of oxygen. It is suspected that solid supports such as C-22 firebrick or celite, may also cause the decomposition of hydrogen sulfide while the latter passes through the column. Two investigations were carried out to determine the existence of such catalytic decomposition and to what extent it may contribute to irreversible adsorption.

The first study was conducted to examine the effect of the presence of oxygen in the hydrogen sulfide sample. The presence of oxygen should increase the degree of "irreversible adsorption" if the hydrogen sulfide is oxidized to free sulfur by the catalytic action of the solid support material. However, negative results were obtained since the presence of oxygen in hydrogen sulfide did not increase the extent of permanent adsorption, but, if anything, reduced it in a few cases.

The second study was made to investigate the effect of low column temperature on hydrogen sulfide adsorption. The favorable temperature for the decomposition reaction of hydrogen sulfide is 200° C, but the decomposition slows down with a decrease in temperature (6). Therefore, if the reaction occurs at all in the gas chromatographic column, it should cease at a low temperature. Experiments were carried out by surrounding the column with dry ice and acetone (−76° C). However, the results obtained were also negative. The irreversible adsorption became stronger at the extremely low temperature and even 2 ml samples of hydrogen sulfide could not pass through a 13 ft long column. Probably the experimental temperature was too low and caused the condensation of hydrogen sulfide gas (b.p. = −61.8° C). Further studies at a temperature of −40° C are scheduled to more fully investigate the effect of low column temperature on the catalytic decomposition of hydrogen sulfide.

Future Plan

This report has been a brief summary of the research progress over the past eighteen months. It is hoped that a comprehensive scientific report, covering the phases presently under investigation, including the complete resolution of hydrogen sulfide, and all previous work, may be written during a final year of support.

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Because they can suffer serious damage, it is imperative to provide positive . . .

Protection of Concrete Sewers
In the Presence of Hydrogen Sulfide

by RICHARD POMEROY,
Consulting Chemist
Pasadena, Calif.

EDITOR'S NOTE: Hydrogen sulfide, present in some sewage in high enough concentration to cause trouble, may pass into the sewer atmosphere and be oxidized on the walls to sulfuric acid, attacking the concrete of the walls. Concrete sewers, therefore, need protection against the acid corrosion. Proper design and operation of sewer systems to eliminate sulfide is of major importance, but the steps indicated in this article may reduce the attack considerably, even when some sulfide still remains.

■ CONCRETE SEWERS are likely to suffer serious damage when they are made to carry sewage containing high concentrations of dissolved sulfide. Some of the hydrogen sulfide, which is present as a part of the dissolved sulfide mixture, passes from the stream into the sewer atmosphere. Then on exposed walls it is oxidized to sulfuric acid, attacking concrete.

Concrete is, nevertheless, the principal construction material for large sewers. In the smaller sizes (generally 36 in. and smaller), it is in competition with vitrified clay pipe. Clay pipe has the advantage that it is not damaged by acid. But the range of conditions under which concrete pipe can be safely used, coupled with its generally lower cost, favor rather wide use in these smaller sizes also.

There are numerous methods, each with its appropriate field of usefulness, for dealing with the sulfide problem. Proper design and operation of sewer systems to eliminate sulfide is of major importance. The limited subject of this article, however, is a review of methods to increase the resistance of concrete pipe against the attack that may result where hydrogen sulfide is present.

Acid-Resistant Barrier on Surface

One approach to the problem is to protect the concrete surface with an acid-resistant barrier. This is difficult, as the protection must reach a high degree of perfection and must have a very long life.

Perfection of the coating is necessary because even one pinhole in 1,000 sq ft might be serious. If sulfide conditions are so bad that protection of this sort is necessary, the presence of an almost-perfect coating leads to deeper penetration than no coating at all. Acid formed on a non-reactive pipe wall will slowly flow down the surface and serve as a supply for rapid attack wherever a flaw exists. In one extreme case, an imperfect lining has resulted in many cavities penetrating all or nearly all of a 5-in. pipe wall in twelve years. It is estimated that the attack would have been only 1 to 2 in. if no lining had been present.

The coating must be able to resist, for a long period of time, exposure to quite high acid concentrations. The acid concentrations generally are not very high on a concrete surface, because the acid can react with the concrete. On an unreactive surface the concentrations are higher. Condensate removed from a clay surface in a junction chamber showed 7% sulfuric acid, the pH being 0.2. Microscopic examinations showed the liquid to be teeming with motile bacteria, presumably of the genus *Thiobacillus*.

Whether *Thiobacilli* can oxidize hydrogen sulfide to sulfuric acid at still higher concentrations has not been determined, but higher concentrations are found, possibly because of evaporation of condensed moisture when the sewage seasonally becomes colder than the walls of the sewer.

When conditions become unfavorable for formation of sulfuric acid, whether because of high acidity, dryness, or other reasons, there may be an accumulation of sulfur as an intermediate oxidation product. In one sewer some sulfur was scraped off the crown of the sewer in February. It contained very little moisture, but that which was present was about 25% sulfuric acid, with a pH of —0.3. The amount of sulfuric acid present was 1 lb per 60 sq ft. Linings will seldom be subjected to the effect of much acid at this concentration for any considerable length of time, but the lining must nevertheless be able to resist chemical alteration under these conditions.

The material must also remain unaltered in the presence of greases, solvents, and solvent vapors in the sewer.

The following principal types of protective barriers have been suggested or used:

1. *Materials that are hot-poured or that harden by evaporation of a solvent.* Many materials in this class found to be effective. Some are not themselves altered, but permit diffu-

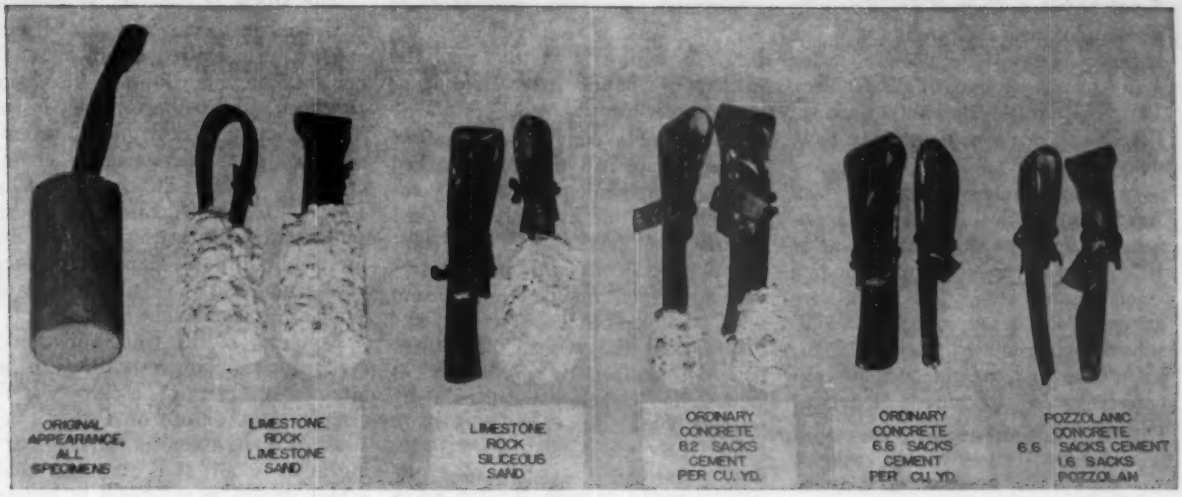
ORIGINAL APPEARANCE, ALL SPECIMENS
LIMESTONE ROCK LIMESTONE SAND
LIMESTONE ROCK SILICEOUS SAND
ORDINARY CONCRETE 8.2 SACKS CEMENT PER CU. YD.
ORDINARY CONCRETE 6.6 SACKS CEMENT PER CU. YD.
POZZOLANIC CONCRETE 6.6 SACKS CEMENT 1.6 SACKS POZZOLAN

FIG. 1. CORROSION of concrete specimens in hydrogen sulfide atmosphere of Norfolk, Va., sewer manhole.

sion of acid through them. Among painted coatings, the best showing has been made by a plastic-base paint. When applied in thick layers it may remain intact for a number of years, and probably for a very long time if no hydrogen sulfide is present. In a test installation where sulfide conditions are bad, considerable deterioration of concrete behind the coating was noted within three years. This coating may have some utility in manholes and other structures under some conditions, but could not be considered for protection of the inside of a sewer.

2. *A material that hardens by chemical reaction after being spread or sprayed on the surface.* One material of this class shows some hope of being effective. It appears to be impermeable, as judged by tests over a period of a few months. It seems likely that it will be durable. The principal question yet to be answered is whether it can be applied so that there will be no flaws and so that it will not develop any cracks, particularly if there is any deformation of the concrete structure, or motion at the joints.

3. *Liner plates.* Clay liner plates have been considerably used, and glass plates have been proposed. The clay products manufacturers have made ingenious advances in attempting to overcome problems of jointing and of permeability of the plates. Another problem is rigidity of the plates. A lined sewer has been observed where the concrete pipe showed no readily measurable deformation, but plates at the sides showed pressure cracks and shear cracks.

It is regrettable that it has been so difficult to adapt so sound a material as vitrified clay to this use, and it is hoped that success may yet be attained. As it stands now, clay liner plates in all installations where high hydrogen sulfide concentrations have prevailed have, within a few years, cracked, spalled, or fallen off in great numbers. Plates have remained intact in some locations, but only where there is little or no hydrogen sulfide.

4. *Plastic sheet.* A plastic polyvinyl chloride sheet, sold as "Amerplate," is the most successful of lining materials attempted up to this time. It undergoes some alteration in the form of loss of plasticizer and absorption of water (up to 8%), but it remains impermeable to acid so far as is known. There is some wrinkling due to expansion under some conditions, and it may tear under heavy stresses, but these are not problems of much importance. The final proof of long life of any material of this sort is obtained only after a number of installations have been in for a long time. There is a pumping station installation which has been in for 13 years, and the oldest sewer installation has been in for nine years. Thus long life has not been proved, yet the behavior of the existing installations seems to warrant the conclusion that one may safely count on a life of 25 years, with good probability of a life of 50 years. A life measured in centuries seems improbable.

Impregnation of the Concrete

Many times, over a period of years, the idea has been brought forward that pores in the concrete might be filled by forcing wax, tar, or some other material into them under pressure, and that this might increase resistance to acid attack. But the problem is not one of acid penetration through the pores; it is acid dissolution of the cement. No such attempted impregnation has been successful in providing protection from acid.

The point is well stated by Suskin (4, p. 186): "Sulfuric acid as such does not and, in fact, cannot penetrate into normal concrete because of the latter's considerable reserve of basic constituents. Acid attack therefore takes place at the surface, the latter receding as solution of the basic material (cement, etc.) takes place."

Vulnerability of porous concrete to attack by sulfate and by leaching might be offset by impregnation, but if a concrete is dense to start with, it is doubtful that this procedure would be of much benefit.

Alteration of Concrete Composition

The relationship of concrete technology to acid susceptibility has been most extensively studied in South Africa, leading to several publications, notably by Stutterheim and Van Aardt (1, 2, 3) and by the

South African Council for Scientific and Industrial Research (4). The latter reference is a book covering many phases of the sulfide problem. Part III, under the authorship of R. Suskin, deals with concrete technology.

In the researches reported by Van Aardt and by Suskin, the test specimens normally were mortar bars of 1 x 1 in. cross-section, having a cement : sand ratio of 1 :3. These were generally immersed in baths of 1% sulfuric acid renewed weekly. Modulus of elasticity, weight loss, and expansion were measured. Principal findings were :

1. A specimen prepared with a water : cement ratio of 0.60 failed much more rapidly than specimens with ratios of 0.35 and 0.45.

2. The poorest method of curing was under water. Long curing in moist air was much better. Steam curing at 95°C for 4 hrs was of moderate benefit. Curing at 75- to 180-psi steam pressure imparted substantially better acid resistance, with specimens lasting about 50% longer than those cured in air. Curing in carbon dioxide was also decidedly beneficial.

3. Increasing the proportion of cement increased the life, roughly in proportion to the cement content, over a range of cement, sand ratios between 1 :2 and 1 :6.

4. There was, in general, an increasing resistance to attack with decreasing tricalcium aluminate content. With 12% C_3A the life of water-cured specimens was about 7 weeks; with 7% C_3A it was increased to about 22 weeks.

5. High alumina cement, blast furnace slag cement, and super-sulfated slag cement were not consistently more resistant than ordinary cement, although super-sulfated slag cement was superior in some cases.

6. Substitution of part of the cement by flyash, underburned kaolin, or a pozzolan did not produce any distinct improvement in acid resistance. The effect of reduction of the proportion of cement, normally decreasing the life, apparently was offset. Addition of these materials without reduction of cement content might be slightly beneficial. Workers elsewhere have in some cases reported more distinct benefits of pozzolans in experiments of this sort. There may be differences in experimental conditions, differences in the pozzolans, and differences in the base of comparison; that is, the quality of the non-pozzolanic comparison specimens.

7. Use of dolomite or limestone for aggregate had the most marked effect in lengthening the life. In comparison with an average life, until break-up, of 35 weeks for comparable specimens with non-calcareous aggregate, one specimen made with dolomite lasted 90 weeks; another lasted 120 weeks. Two others had not broken up at 80 to 90 weeks, but had lost most of their weight. A specimen made with limestone had not broken up at 90 weeks, and had lost only about 25% of its weight and 20% of its modulus of elasticity. By extrapolation it would appear that it might last 180 weeks or longer.

8. A change in the grading of the sand showed no significant effect.

9. An increase in the length of time of spinning of concrete pipe beyond the normal time did not have any significant effect upon the acid-resistance of prisms cut from the pipe wall. Also, there was no significant difference in resistance between prisms from spun and from pressure-compacted pipe.

10. Attempts to prevent the growth of *Thiobacilli*, and hence the oxidation of H_2S to sulfuric acid, by incorporating toxic substances into the concrete, did not give promising results.

Hansen, Vellines and Brandvold (5) in the United States made experiments with Type I cement (12.7% C_3A), Type II cement (8.5% C_3A), and super sulfated blast-furnace slag cement. Cylinders of 2 x 4 in. size were immersed in 0.055N sulfuric acid (0.27%).

A cylinder made with Type I cement broke up at 47 weeks with clear evidence of sulfate attack. The other two did not show evidence of sulfate attack and lasted much longer. In an exposure regime in which specimens were immersed, each week, for three days in acid, 3 days in water, and one day in warm air, all three compositions showed similar slow attack. Pipe specimens, 6 x 12 in., made with these three compositions all showed similar attack. The water-cement ratio used in making the cylinders was 0.47; in making the pipes it was 0.30.

The attack of concrete by sulfuric acid can be considered to be due essentially to hydrogen ion, but it is evident that sulfate ion may also have an effect. Among the variables tested in the South African work, several were related to resistance of the concrete to sulfate attack, expecially Items 1, 2 and 4. Susceptibility to sulfate attack clearly shortened the life. The work of Hansen, Vellines and Brandvold (5) also disclosed similar effects of sulfate ion.

From all of the results it would appear that sulfate resistance can be attained by use of a low water-cement ratio, or use of Type II instead of Type I cement, or long curing in moist air. It is also clear that a high degree of resistance to sulfate attack will not prevent concrete from being destroyed by the hydrogen ions of the acid.

All of the foregoing tests were accelerated laboratory tests, under conditions quite different from those found in sewers. In the laboratory, the concrete is exposed to a virtually unlimited reservoir of acid. In the sewer, acid is formed on the walls very slowly. That which forms must either react or flow down the walls into the sewage stream. In pipes that have suffered rapid attack, one may find evidence that acid has streamed down the walls, as shown by grooves. Where the attack has been slow, one usually finds a softened layer over the interior of the pipe, perhaps varying in thickness between soffit and water line, but otherwise fairly uniform, without evidence of flow of acid.

A substantial relative increase in durability of the concrete is of minor interest if the pipe will fail in five or ten years anyway. Chief interest in modification of the concrete is for those places where this may extend the life from, for instance, 25 years to 100 years. These are the places where substantially all of the acid may react regardless of variations of concrete composition. Therefore, caution must be used in interpreting results of the laboratory experiments in terms of long years of life of sewer pipe.

The effect of calcareous aggregate, first advocated by Stutterheim and Van Aardt (1), is especially significant. There is every reason to suppose that the beneficial effect of calcareous aggregate on durability of concrete will be at least as pro-

nounced for a sewer pipe carrying moderate sulfide concentrations as for the bars immersed in acid in the laboratory. Use of calcareous aggregate will not change the rate of reaction of acid on the sewer wall, because substantially all of the acid will react anyway. But use of limestone or dolomite aggregate will increase by at least five-fold the amount of acid required to react with a cubic foot of concrete. It is to be expected that there would be a corresponding slowing of the rate of penetration of concrete.

An attempt was made to test calcareous aggregates in sewer atmospheres. Specimens of five different compositions were prepared, in the form of 2 x 4 in. cylinders. These were placed in duplicate in a manhole in Norfolk, Va., through the cooperation of the Hampton Roads Sanitation District. The manhole was at the end of a force main, with extremely severe hydrogen sulfide conditions. When the specimens were removed in less than a year, corrosion was far advanced (Fig. 1).

In a place where the air is turbulent, various specimens do not have the same exposure. Unless their places are exchanged from time to time, one does not necessarily get a true picture of their relative susceptibilities. Thus, the two specimens of the second mix (limestone rock, silicious sand) show very different amounts of corrosion. But if one considers the average performance for each pair, the results seem to offer quite strong confirmation of the deduction that the life is increased by incorporation of limestone.

Occasionally, in the United States and elsewhere, limestone has been used for concrete pipe because it was the available aggregate. Specifying limestone aggregate for fortifying sewer pipe against acid attack is relatively new. On the basis of a publication by Stutterheim and Van Aardt (1) and the results of the tests shown in Figure 1, the City of Tuscaloosa, Ala., specified limestone aggregate for trunk sewers where there was a likelihood of a small amount of sulfide, or where a factor of safety was desired. Several miles of trunk sewers in sizes up to 48 in., were installed there in 1958, using concrete pipe having limestone aggregate. The City of Palm Springs, California, is presently requiring limestone aggregate for some of its sewers.

Additional Concrete

A good protective material for concrete is concrete. The rate of penetration of ordinary concrete is slow under moderate sulfide conditions. In 1946, Pomeroy and Bowlus (6) made an estimate that under average flow conditions (velocities of 2 to 3 fps) an average dissolved sulfide concentration of 0.1 ppm would lead to attack of the interior of a concrete sewer at a rate of about 1 in. in a century. This estimate still appears valid. This would generally mean average daytime concentrations and average summer concentrations considerably higher, with summer total sulfide concentrations reaching peaks of 2 to 3 ppm. There are a good many sewers where concentrations as high as this may be found. Rate of penetration is proportional to the dissolved sulfide concentration, other things being equal. The value of extra concrete where moderate sulfide conditions prevail is evident. Many cities have required 1 in. or 1½ in. of extra concrete in pipes where sulfide conditions are likely.

Even in the presence of severe sulfide conditions, with maxima of 10 to 15 ppm total sulfide, concrete pipe can be given long life if it has both extra thickness and limestone aggregate. Rarely should this be necessary for sewer pipe. For junction chambers and other structures where there is much turbulence, with abnormal release to the air of hydrogen sulfide, and for manholes at the ends of long force mains, this combination of protective measures may be desirable.

Summary

1. No kind of hot-applied or solvent-applied coating has been found which holds promise of usefulness for protection of the interior of concrete sewers against the acid formed where high sulfide concentrations are present. A resin polymerized in place has a possibility of being beneficial.

2. Clay liner plates have remained intact only where there is practically no sulfide in the sewage, or where they are submerged daily.

3. A polyvinyl chloride sheet, "Amerplate," is successful. Its life is not known. A guess, based on the limited information available, is that it exceeds 25 years but is less than a century.

4. Attempts to increase resistance of the concrete to acid attack in sewers by impregnating the pores of the concrete with any material are futile.

5. When immersed in acid, concrete specimens prepared in ways which give them high sulfide resistance last longer than do specimens having poor sulfate resistance. Sulfate resistance is imparted by attaining a concrete of low permeability, by use of Type II instead of Type I cement, or by favorable curing procedures.

6. Interpretation of results of laboratory tests in terms of probable life in a sewer must be done with caution, because of the lack of similarity. Under conditions of slow acid production on the inside of a sewer, the rate of reaction of the acid is usually the rate of acid production.

7. Rate of attack, other things being equal, is inversely proportional to the amount of acid-neutralizing materials, including cement, in the concrete.

8. Limestone or dolomite aggregate retarded the attack of concrete specimens immersed in vessels of acid, of specimens hung in a manhole with very high sulfide concentration, and of pipe laid in a line carrying septic tank effluent. Use of either of these alkaline aggregates is expected to increase the life of a concrete sewer, in a place where sulfide conditions prevail, by at least five fold.

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The Ruidoso, N. M. Plant, financed by relatively few residents is effective . . .

Treating Seasonal Sewage Flows

by CHARLES G. CALDWELL,
State Dept. of Pub. Health,
Sante Fe, New Mexico

EDITOR'S NOTE: A story is told here about how a small town of 3,000 population met its needs for a sewerage system to serve a summertime population of 20,000. The cost of this undertaking had to be borne by the few permanent residents and was difficult. However, the improvements had to be made if the community was to continue to prosper as a vacation area.

■ RUIDOSO, in Lincoln County, New Mexico is a summer vacationland. It is indeed a beautiful little vacation town which nestles in a steep, wooded canyon. Another great attraction is the horse racing every week during the summer season which brings people from all over the State and from neighboring states to join the weekend racing crowds. This created a problem when it came to designing a sewerage system for the community. The permanent winter population was about 3,000, but in the summer, the racing crowds swelled the population figure to over 20,000 on week ends.

The town had no sewage system of any kind at one time, but depended upon cesspools, septic tanks and privies. Due to the rock formations the cesspools and septic tank arrangements did not function satisfactorily, and most of the sewage of the town went directly into the Rio Ruidoso. This little stream which normally would have been a tourist attraction, was in fact an open sewage ditch, a menace to public health and a big problem in the opinion of the Health Department.

Not too many years ago, in fact, the town used this raw river water, with simple chlorination, as a source of domestic supply. At the urging of the Health Department, the town built two complete water treatment plants and constructed a comprehensive water distribution system. As a result, the town developed rapidly and with this expansion came more sewage, with overflowing cesspools and septic tanks, and a continuous degrading of the stream. If development was to continue the village would have to recognize the need for a comprehensive sewer system and treatment plant.

In late 1957 the Village officials made application to the New Mexico Department of Public Health for a Federal grant under the provisions of Public Law 660. A Federal grant of $120,164.40 was approved for the job. Since only some of the sewer system cost is eligible for federal participation, the village's share came to $503,818.59, making a total cost of $623,982.99. The village decided to finance their costs using both revenue and general obligation bond money. It is intended to charge a flat rate of $2.00 per month for single dwelling units, and a percentage of the water charge for multiple dwellings and commercial units, to pay off the bonds.

The big problem was how to design a plant for the large summer crowds, that had to be financed by the relatively few permanent resi-

dents. It was also realized that the week end crowds would not contribute normal amounts of sewage; that is, in the range of 80 to 100 gpcd. After much study and considerable discussion between the engineers and the Health Department, it was agreed that a fair design figure could be based on 32 gpcd for 20,000 people. It was agreed that dual rectangular primary settling tanks would serve to the best advantage. These would lend themselves to handling the increased flows during the summer, and one unit would suffice for good service during the winter when the population was down to 3,000. Secondary treatment was the next concern, and required a great deal of thought. Good BOD reduction was needed on a year-around basis since the Rio Ruidoso is a small stream. Although the stream is small, it is used for recreation and stocked with trout.

It was decided to build two trickling filters that could be operated separately or in a series. The primary filter is 6 ft. deep and 50 ft. in diameter. The secondary is 6 ft. deep and 60 ft. in diameter. During the winter, one or both filters can be operated as standard filters. Recirculation pumps have been installed so that during the peak load on summer week-ends, the filters can be operated as high-rate filters. In addition to a dual secondary clarifier, a chlorine contact chamber was also constructed. This chamber is designed to give 24 minutes contact time at average flow, and 15 minutes for peak flows. It was deemed advisable to include chlorination because of the extensive recreational use of the stream. Also despite warnings people will drink from streams. The chlorination provides just a little added insurance, and also further reduces the effluent BOD discharged to the receiving stream.

It is felt that a flexible and well constructed plant has been designed to handle an unusual situation. The sewerage system was needed for a long time, both to protect the Village of Ruidoso, and to protect the rights of downstream users.

In addition to the plant itself the village has installing 2900 ft. of 12-inch sewer, 5100 ft. of 10-inch sewer, and about 20,000 ft. of 8-inch sewer; 110 standard manholes and 20 drop manholes. This system will serve about 75 per cent of the population areas. The remaining 25 per cent are mainly isolated cabins, inhabited only for short periods of time during the summer months. Many of these do not have water-carriage toilet facilities, but rely on pit privies.

Much credit is due Ruidoso, its Mayor and progressive village council because the problems of financing a large construction project were very difficult. The relatively few permanent residents of Ruidoso have every reason to be proud of the new sewage plant and collection system.

DUAL FINAL CLARIFIERS and chlorination house are shown in center of top photo. The dual primary settling tanks and scraper mechanisms are best illustrated in the center photo; the floating cover digester and dual trickling filters are presented in the bottom picture.

How odors are being successfully controlled at . . .

Baltimore County Sewage Pumping Station

By GEORGE W. WELSH, JR., Chief,
Bureau of Utilities
Department of Public Works
Baltimore County
Towson, Maryland

EDITOR'S NOTE: Mr. Welsh describes here the correction of serious odor conditions at Baltimore County sewage pumping stations. Used on a year-round basis, the system has been very successful in eliminating odors.

■ OPERATION of some of our sewage pumping stations has made it essential that we provide some type of odor control. As a result of numerous experiments at our most troublesome stations, odors are being controlled and complaints have been eliminated.

The Metropolitan District of Baltimore County, Maryland, has approximately 900 miles of sewers, with 60 to 70 miles being added each year. Presently the system includes 58 pumping stations, twelve ejector units, three water booster stations and three sewage treatment plants. Topographic conditions and station location adjacent to private residences made it mandatory that odor control measures be instituted.

Greenridge Sewage Pumping Station, the cause of numerous odor complaints, receives gravity flow sewage, plus sewage from five other stations. One of these is two miles away and the sewage deteriorates substantially by the time it reaches the Greenridge Station. Several odor control methods have been attempted; some were not successful, others were economically prohibitive. The present system consists of forcing air through a balsa wood tray saturated with SanFax*. At Greenridge station, a ½ hp, 12 in. explosion-proof blower (Figure 1) is installed over a manhole opening so that exhaust from the manhole passes through the tray and out a 35 ft. stack to atmosphere (Figure 2). A close-up of a typical louvered tray is shown in Figure 3. Normally the tray is saturated once each day in full strength de-odorizing solution. However, during periods of high humidity it is saturated twice daily.

A similar installation at the Patapsco Sewage Pumping Station, has also proved successful in reducing odor complaints. At this location, the stack was installed through the wet well slab, Figure 4, and an existing ventilator, Figure 5, by reversing its motor was converted to an air inlet duct. A one-h.p. explosion-proof blower is used to force air through the trays shown in Figure 6.

Sizing of the equipment was not determined by computation. We made use of materials that were readily available in our yard. The results have been highly satisfactory, and we operate the odor control systems on a year-round basis. Our success has prompted us to request the En-

FIG. 1. EXPLOSION-PROOF blower at Greenridge Pumping Station has ½ hp motor and 12" fan. Louvre below water is saturated daily with de-odorizing liquid.

FIG. 2. VIEW of Greenridge Station showing 35' stack fabricated from coated steel pipe. Stack is located over station manhole.

*Product of Sanfax Corp., Atlanta, Ga.

FIG. 3. CLOSE-UP of louvered balsa tray as used in odor control installations.

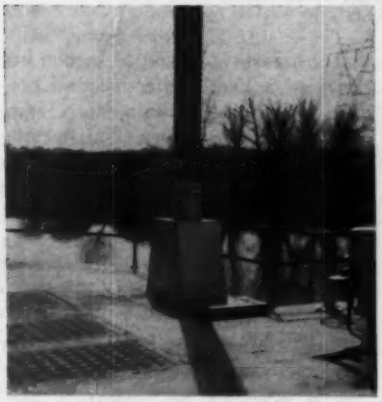

FIG. 4. INSTALLATION of vent stack in Patapsco Pumping Station's wet well slab. Blower and trays are located in plenum at base of stack.

gineering Bureau to provide stack connections in wet well slabs of future pumping stations. This will make it relatively easy for us to complete the installation if the future need arises.

FIG. 5. MOTOR in ventilator at Patapsco Station was reversed to draw air into wet well. Stack shown in background is 40' tall.

An electric fogging machine*, Figure 7, is used in areas that develop temporary odor problems. Operating on 110v, the fogging apparatus can be quickly attached to any standard 55 gallon drum. One-half gallon of deodorizer is added to the empty drum, the drum is filled with water and taken to the station where the fogging machine is attached. This dilution has given very satisfactory results and the machine will operate unattended for many hours. The fogging machine pressurizes the drum to assure consistent output until the drum contents are exhausted. The equipment is furnished and maintained by the manufacturer.

*Product of Sanfax Corp., Atlanta, Ga.

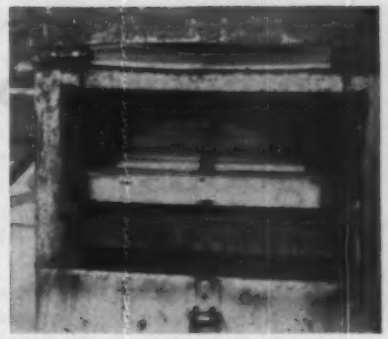

FIG. 6. TRAYS installed above blower at Patapsco Station slide out for dipping into undiluted deodorizer. Opening is provided with hinged cover.

FIG. 7. GENERAL SUPT. of Pumping Division, L. A. Hauptman holds portable motor-driven fogging machine used to combat temporary odor problems.

Sewer Completion Eliminates St. Louis Health Menace

One of the most dangerous and long-standing public health menaces in the metropolitan St. Louis area was completely eliminated last July when the last leg of the $1,700,000 Maline Creek Sanitary Trunk Sewer was put into operation at the Walton Road Treatment Plant.

With the last link in the trunk line completed, the seven-mile long sewer has bottled up all sanitary sewage, most of it raw, from a 25-square-mile area of North St. Louis County that formerly made the creek a vast, open sewer. The pipe, ranging up to five feet in diameter, drains all or parts of the cities of Ferguson, Kinloch, Berkeley, Bel Ridge, Moline Acres, Bellefontaine Neighbors and Northfield Gardens, as well as many subdivisions and unincorporated areas within the watershed.

Noxious odors and overall pollution in the creek had become so severe throughout the area several years ago that paint on homes bordering the stream actually turned black; numerous cases of illness due to sewage fumes were reported and outdoor activities during the hot summer months were virtually impossible. The facts were pointed out by MSD officials reviewing the steps that led to voter approval of the bond issue and construction of the sewer.

Shortly after MSD began active operations, the $1,700,000 bond issue was overwhelmingly approved. This was on February 7, 1956, and it was MSD's first major program to abate pollution of the country's creeks.

That the trunk sewer has been a factor in the rapid development of the Maline Creek watershed is illustrated by the decreasing tax rate MSD has authorized to retire the bond issue: First year's rate, 1957, was 20c per $100 assessed valuation. Development increased so rapidly that higher assessed valuations for 1958 permitted a 5c reduction to 15c, and a 12c rate in 1959. The 12c rate will hold for this year.

There are two ways of demonstrating one's strength; one is pushing up, the other is pulling down.—*Booker T. Washington.*

Design, Construction, Operation and Maintenance Were Reviewed at . . .

Symposium on Waste Stabilization Lagoons

Report by Donald M. Pierce, Chief
Section of Sewerage and Sewage Treatment, Div. of Engr.
Michigan Department of Health
Lansing, Michigan

EDITOR'S NOTE: This Symposium came none too early to provide documentation of evidence gained since the earliest experience with waste stabilization lagoons three decades ago. Among other things, the Symposium leaders agree that the lagoon has its place among the family of treatment processes. They agree further that the system is not a "cure all", that it requires proper design, construction and operation, and that operational problems must be faced and dealt with promptly and properly. The Symposium must necessarily be followed now by establishing firm design criteria and freezing existing regional and state summary statements into full-fledged attainable standards.

■ TREMENDOUS NATION-WIDE INTEREST in waste stabilization lagoons for treatment and disposal of sewage and industrial wastes was evidenced by attendance of more than 300 engineers, chemists and others at this Symposium in Kansas City, Missouri, August 1-5, 1960. Arranged by Glen Hopkins, Regional Engineer, United States Public Health Service, Region VI, at the request of the State Sanitary Engineers of the Ten Missouri Basin States comprising the Missouri Basin Engineering Health Council, the Symposium was organized to review the experience of these states and other areas in the design, construction, operation and maintenance of a wide variety of waste stabilization lagoons and oxidation ponds.

Consulting engineers, state regulatory agency engineers and chemists, municipal officials and engineers and others interested in this increasingly popular method of waste treatment rubbed elbows and participated actively and spiritedly in discussions of the technical papers and in small unscheduled groups throughout the first three days of the formal program. Interest remained high during the scheduled inspection tours to operating installations on the last two days. Thirty-two states, eight foreign countries, several educational institutions and all of the regions of the United States Public Health Service were represented.

Giving national flavor to the technical sessions were formal papers presented by state regulatory personnel from Alaska, Texas, Virginia and Mississippi, United States Public Health Service personnel of the Robert A. Taft Sanitary Engineering Center at Cincinnati and Communicable Disease Center at Atlanta, Georgia, and the University of California. Experiences and practices in foreign countries were related in papers presented by engineers representing the Province of Alberta, Canada and Melbourne, Australia.

General Theme and Consensus

A single thread of thought and conviction, spun by the first speaker and woven throughout the five days by all participants, impressed the audience that the waste stabilization lagoon has provided a highly effective and economical means of treatment of sewage and other wastes. Satisfactory performance at hundreds of installations, constructed under widely varying conditions of loading and climatic conditions, were cited as proof of the efficacy of the process and that it has come of age as a well-established method.

Equal emphasis was given by all the process is not a "cure-all", but rather that it occupies an important and significant place in the family of treatment processes. The importance of proper design, construction and operation was emphasized by even the most ardent supporter. The influence of rainfall, evaporation, percolation, ground water table, soil conditions, surface runoff and many other factors on the design and operation and maintenance practices were reviewed. Also discussed were problems of location and controls governed by possible adverse effects of odors and mosquito breeding on enjoyment and use of nearby property.

Origin of the Process

Several of the speakers claimed for their state the distinction of installing the first lagoon for sewage treatment. The record will probably remain vague on this point.

In his discussion of the history of raw sewage lagoons in the Midwest, Jerome H. Svore, Regional Program Director, United States Public Health Service, Region VII, stated that Maddock, South Dakota was the first municipality in the Midwest to construct a pond for the sole purpose of treating sewage. This was in 1949. The City of Fessendon, North Dakota, however, has used a pond to re-

ceive raw sewage since 1928. In the Southwest, similar experience dates back to 1901. San Antonio, Texas, was one of the early unformalized installations of this type, discharging its sewage into a natural lake area.

C. D. Parker of Melbourne, Australia, reported that this city has been lagooning sewage for the past 25 years.

In his observations on the growth, application and operation of waste stabilization lagoons, W. W. Towne, Chief of Field Operations Section, Technical Service Branch Water Supply and Pollution Control of the United States Public Health Service, stated that stabilization ponds are probably one of the oldest methods used for secondary and tertiary treatment. He considered the year 1948 as the time when lagoons first came to be recognized as a regular method of treatment for raw sewage.

Prevalence

An inventory of sewage stabilization lagoons in the United States today, as reported by W. W. Towne, lists 443 projects in 30 states. He said that this inventory is incomplete, both as to date and number of states, since it is known that there are installations in 39 states. He further reported that as of May, 1960, 418 raw sewage lagoons had been approved in 27 states for Federal financial assistance by the United States Public Health Service under Public Law 660. The total number of projects for all types of sewage stabilization lagoons, approved for Federal aid under this program was 631 when last summarized.

David F. Smallhorst, Director of Water Pollution Control, Texas State Health Department, stated that ponds in Texas have always been used for secondary treatment in many areas by reason of adaptability to an arid climate and little or no seasonal flow in many of the streams. Of the 700 sewage plants in Texas today, about 200 are followed by ponds of the flow-through type. He reported that there are 274 stabilization lagoons recognized in Region VII of the United States Public Health Service in Arkansas, Louisiana, New Mexico, Oklahoma and Texas.

A further indication of the prevalence of waste stabilization lagoons in the Midwest was provided by Daniel J. Weiner, Chief, Construction Grants, United States Public Health Service. Region VI, stating that 452 projects have been approved in this Region.

In Missouri alone, Jack K. Smith, Executive Secretary, Missouri Pollution Control Board, reported that 247 lagoons of all types are in operation today serving 300,000 population.

H. L. Hogge, Director, Division of Sanitary Engineering, Department of Public Health, Province of Alberta, said that there are a total of 114 lagoons now in operation in Alberta.

Terminology

Terms such as waste stabilization lagoons, waste stabilization ponds, sewage oxidation lagoons and oxidation ponds were used by the speakers often interchangeably. Continuing discussion among the participants during the sessions emphasized the need for development and universal use of standard terminology. It was quite generally agreed that the term "waste stabilization lagoons" connotes treatment of raw sewage or other wastes as differentiated from "oxidation ponds" or "oxidation lagoons" which refer to secondary or tertiary treatment.

Theory to the Process

The stabilization process is recognized as consisting largely of sedimentation, precipitation of organic salts and the interaction of bacteria and algae. Bacteria digest and oxidize the constituents of the waste. The soluble nutrients, principally carbon dioxide and ammonia, are utilized by algae which liberate oxygen by photosynthetic action. The oxygen in turn is used by the bacteria. This symbiotic cycle is a continuous one under normal conditions. Cold weather reduces the speed of the reactions and ice cover completely stops the algae activity.

Anaerobic action in the lower layers, particularly near the inlet, and the aerobic action in the surface layers proceed simultaneously.

Application and Use

Nearly all the speakers reported use of stabilization lagoons and oxidation lagoons for a wide variety of wastes and circumstances.

For treatment of sewage, the waste stabilization lagoon has been used widely by municipalities to treat sewage from the entire community or from portions thereof, by motels, shopping centers, schools, small industries and many other establishments. Many industries have used these lagoons for the raw wastes from creameries, chicken slaughter houses, oil refineries, and other operations. In Missouri a lagoon was used for treatment of laundry wastes.

The lagoon has been used extensively also as secondary or tertiary treatment following primary waste treatment plants or secondary treatment plants.

In some arid areas of the country, the lagoon has been used for total containment of the flow where the ratio of evaporation losses to precipitation is relatively high. The Indian Service has used lagoons quite extensively for this purpose.

Design Standards and Criteria

Recommended practices for design, construction, operation and maintenance of lagoons have been developed by several states both individually and jointly with other states. These are summary statements based on observations of operating installations rather than strict design standards. Most of these emphasize the importance of thorough and competent analysis by the consulting engineer of influencing factors such as: variations in water quality, rainfall, evaporation, soil conditions, temperature, winter operation in colder climates particularly where ice cover is expected, per capita water consumption, the receiving stream as to nature, use and rates of flow and many other engineering considerations, including decision on whether to operate in parallel or series and whether conditions require self-containment for certain seasons for the year.

Such a statement of practice and general guide was adopted by the Missouri Basin Engineering Council in January, 1960. The states of Colorado, Iowa, Kansas, Minnesota, Missouri, Montana, Nebraska, North Dakota, South Dakota and Wyoming comprise the Council.

The Great Lakes-Upper Mississippi Board of State Sanitary Engineers included guide lines based on their experience and needs in Recommended Standards for Sewage Works adopted in May, 1960. Signatory states are Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, New York, Ohio, Pennsylvania, and Wis-

consin. Much of the basic information in these so-called standards was drawn from the experience of the Missouri River Basin States.

Loading

It has been general practice among most of the states participating in the Symposium to limit loadings to a nominal figure of 100 persons per acre per day or 20 lb of 5-day BOD per acre per day. Experience reported by several of the speakers indicated no reduction in treatment efficiency or increase in odor production with loadings up to 40 lbs of BOD per acre per day or even higher in a few instances where climatic conditions and design features are unusually favorable.

In the states of Wisconsin and Minnesota, less favorable climatic conditions require loadings to be kept at the lower level. It was generally agreed that anaerobic conditions prevail in the lagoons with ice cover, that biological activity is practically stopped, some acid digestion develops with a very low pH, hydrogen sulfide is produced, and odors are generated for short periods even at this lower loading.

The research lagoon insallation at Fayette, Missouri, operated by the United States Public Health Service during the past three years, has provided much valuable performance data with varying loadings and control methods. These studies have been conducted with the cooperation of the city of Fayette, which furnishes the wastes, and the Missouri Water Pollution Commission. Joel K. Neel, Biologist of the United States Public Health Service, outlined the studies performed thus far in a continuing program. The installation was completed during the fall of 1956 and studies commenced in May, 1957. Wastes from a sewered population of 2,700 including some small organic industries have been treated in the lagoons since then.

The Fayette lagoons consist of 5, one-acre and 1, fifteen-acre unit. The lagoons have been loaded at 20, 40, 60, 80, and 100 lbs of BOD per acre per day and operated in series with the 15 acre lagoon. Preliminary information indicates that 40 and 60 lbs loadings produce results quite similar to the 20 lb loading.

E. C. Cooley, Sanitary Engineer, Virginia Water Pollution Control Board, reported on the results of variable BOD loading at Farmville, Virginia, a city of 5,000 population. Loadings varied from 20 to 60 lbs BOD per acre per day. About 80 per cent reduction in BOD through the pond was noted regardless of the load imposed. Very little odor was reported beyond 200 feet.

R. J. Schliekelman, Public Health Engineer, Iowa State Health Department, has found that a loading of 20 lbs has been most successful in Iowa and is their current recommendation, in recognition of rather severe winters with some ice cover. A lesser period of recovery in the spring breakup has been noted than with higher loadings. For schools, lagoon size in Iowa is based upon total retention without overflow at loadings of 0.1 acre per 100 students, assuming 10 gallons per student per day. Similar experience was reported by Harvey Rogers, Executive Engineer, Water Pollution Control Section, Minnesota State Department of Health.

C. D. Parker, Chief Chemist and Bacteriologist, described an oxidation pond at Melbourne, Australia, receiving the effluent from an overloaded trickling filter plant. The filter effluent, containing 60-70 mg/1 of BOD, is discharged to 25 acres of ponds at rates of 1.5 mgd. Pond effluent contains about 5 mg/1 of BOD. Algae concentration is relatively quite low compared with effluent from lagoons receiving raw sewage in series.

Anaerobic-Aerobic Operation

William J. Oswald, Professor of Sanitary Engineering and Public Health, University of California, discussed research projects under National Institutes of Health grants at the University. He classified lagoons and ponds from a biological viewpoint as anaerobic, facultative and anaerobic. Anaerobic action alone is found in stabilization ponds with detention of a few days receiving extremely high organic loadings. The term "facultative pond" or lagoon connotes the simultaneous occurrence of anaerobic and aerobic action in the same pond. In his opinion, about three-fourths of the stabilization lagoons in this country today are in this class. The term "aerobic ponds" applies to those oxidation ponds used for secondary or tertiary treatment following waste stabilization lagoons or treatment plants. In these ponds algae provide all of the action. Studies have indicated that short period anaerobic treatment in a separate pond provides an economical method of stabilization of a substantial fraction of the BOD. Designs with a relatively small depressed section in the facultative lagoon at the point of inlet for the raw waste has proven to be a practical means for effectively carrying out the anaerobic phase of treatment.

Parker reported successful operation of aerobic ponds following anaerobic lagoons in Australia. At one installation the anaerobic lagoons, three feet deep, are loaded at rates of 1200 lbs BOD per acre per day with temperatures at about 70°F and reduced to 300-400 lbs when temperature fell around 40°F. He reported reduction of sulfides from 5 mg/1 to 2 mg/1 when aerobic ponds, 2 to 4 feet deep, are loaded at 60-100 lbs BOD per acre per day. The required surface area is about 6 for aerobic to 1 anaerobic.

F. W. Sollo, Sanitary Engineer, Swift and Company, outlined experience at Moultrie, Georgia, where an anaerobic lagoon was used for treatment of meat packing wastes. The lagoon had a depth of five feet. The waste after presedimentation had a 5-day BOD of 1680 mg/1. Removal was 78.6% at 72°F with a detention of 4.4 days. Digested sludge from a sewage treatment plant was used as a starter. No objectional odors were produced in the lagoon. In series operation with a 50-day detention period in the second pond and with a raw waste loading of 820 mg/1 BOD, the primary pond effluent was 284 mg/1 and the second pond effluent 116.

Towne reported on an installation in California where loadings of 185-450 lbs BOD per acre per day were reduced in the anaerobic lagoon by 40-70% averaging about 60 per cent reduction. Loadings on the following aerobic unit in the range of 30-40 lbs per acre per day were reduced by 50-55% with overall plant reduction of 74-96%. Odors were controlled in the anaerobic lagoon by recirculating from the aerobic pond to the anaerobic lagoon for about two hours in the afternoon.

Control of Floating Material

Methods of control of floating masses of decomposing solids and dead or dying algae which may ac-

cumulate in corners or ends of the stabilization lagoons were discussed by several speakers. It was agreed that such materials should be broken up as promptly as possible after accumulation to prevent development of anaerobic conditions at the surface and to prevent odor production. Outboard motors have been used effectively for this purpose. Recirculation of this material to the pond inlet is very effective and may be required in some instances for anaerobic lagoons.

Required Isolation

Requirements or recommended practices among the reporting states for distance of isolation of waste stabilization lagoons from residential areas varied widely. The principal reasons for isolation are the same as for sewage treatment plants: odors and other aesthetics. Some of the speakers recommended ¼-mile from residential developments, particularly in areas where winters are severe. Others stated that as little as 200-300 feet has produced no complaints. Still others recommend as much distance as practicable.

Generally, greater distance is needed where anaerobic lagoons are installed than for the typical long detention stabilization lagoon. Still less distance is usually required for oxidation ponds following sewage treatment plants or used in series with stabilization lagoons.

Control of Vegetation

Two cardinal principles were emphasized by most of the speakers: Emergent plants, in the lagoons or ponds must be controlled by maintenance of a minimum water depth of 18-24 inches or more; and vegetation around the periphery, particularly at the shore line, must be kept under control. Both types of growths, when extensive, interfere with the treatment process by reducing water movement, excluding sunlight and imposing an organic loading as the vegetation dies. Vegetation also provides a satisfactory habitat for mosquitoes.

Control of Mosquitoes

John A. Rowe, Chief, Communicable Disease Center Services, Region VI, United States Public Health Service, stated that extensive field investigation has demonstrated that mosquitoes breed in waste stabilization lagoons or oxidation ponds only when there is emergent or peripheral vegetation or when there are small clumps of algae mats.

In the Midwest and Southwestern states *Culex tarsalis* and *Culex pipiens* are the main species found. These are primary vectors of encephalitis. He stated that their heavy production at improperly maintained lagoons and ponds constitutes a tremendous hazard to public health, particularly in many areas west of the Mississippi River where there are very few natural breeding areas.

Peripheral vegetation may be controlled by proper construction of a clean shore line with good alignment, seeding or sodding of the dykes, regular mowing and prompt control of weeds before they get out of hand.

Reduction of Coliform Organisms

Reduction of coliform oxganisms by waste stabilization lagoons or oxidation ponds is about the same magnitude as provided by the activated sludge process.

E. C. Cooley of Virginia reported a reduction of about 90% with an MPN of 100,000 to 1,000,000 per 100 mls in the effluent at the Farmville plant where BOD reductions ranged about 80 per cent. Better reductions were reported by Jack Smith from studies at Montgomery, Missouri, where the MPN was 46,000 on one study when BOD was 17 mg/1. The impression was quite general that coliform concentrations are substantial, but that more observations made under varying conditions of design, loading and operation are needed to establish the predictable ranges.

Disinfection of plant effluents is seldom practiced at the installations discussed. In a discussion on disinfection, Oswald pointed out that to effectively kill the coliform group of organisms the algae will also be killed. He stated that 1 mg/1 of dead algae is equivalent to about 1.5 mg/1 of 5 day BOD. With algae concentrations in these effluents ranging from 50 to 125 or more mg/1, the BOD discharged to the receiving stream would be in order of 75 to 150 or higher. This renders disinfection of the effluent impracticable for most circumstances.

Advantages of Lagoons

The principal advantage of waste stabilization lagoons and oxidation ponds, recognized by all of the speakers, is lower capital cost and lower operating costs than even primary treatment plants. Comparative cost analyses were presented by Daniel J. Weiner. Data was collected from 262 projects including 160 lagoons and ponds constructed under the Federal assistance (PL 660) program. The study was based on hydraulic and organic loadings.

The following data were presented:

Construction Costs Comparison of Lagoons with Other Methods of Sewage Treament

Type of Facility	Construction Cost per Capita for Populations as Indicated		
	100	1,000	10,000
Plant-Primary	77.9	40.1	20.6
Plant-Secondary	127.3	64.8	33.
Oxidation Ponds	105.2	53.3	27.
Stabilization Lagoons	29.	18.5	11.7
Stabilization Lagoons Plus Interceptor Sewer	69	34.8	17.3

Others indicated that costs, both capital and operating, were usually less than half the cost for equivalent treatment by orthodox conventional treatment plants.

Other advantages recognized are ease of expansion, permitting additions in stages when needed, and recovery value of lagoon property when subsequently converted to residential or other type development in suburban installations when interceptor sewers become available.

Disadvantages of Lagoons

Compared with effective conventional treatment works, properly operated and maintained, the lagoon or oxidation pond may have the following recognized disadvantages:

1. More disagreeable odors produced under adverse circumstances such as overloading and for short periods following spring breakup of ice cover and prolonged cold weather.
2. Greater potential for disease vectors such as mosquitoes transmitting encephalitis.
3. Greater difficulty in effective disinfection for control of disease transmission.

Field Inspections

Guided field inspections by chartered bus were conducted by Region VI USPHS staff. Fifteen waste stabilization lagoons and oxidation ponds were visited by the majority of Symposium attendees.

The Publisher Announces

Virgil Langworthy Appointed Editor

WATER & SEWAGE WORKS is pleased to announce that Virgil W. Langworthy has been appointed Editor.

Mr. Langworthy, who assumed his new position on October 1, will direct the editorial policies of WATER & SEWAGE WORKS, as well as supervising the overall promotion and production.

Virgil has had extensive experience in the field as a Water Conditioning Plant operator and Superintendent, Research Chemist, Project Engineer, Lecturer, and author.

Graduating from Michigan State University in 1956 with a degree in Bacteriology and Chemistry, and after spending 3 years on active duty with the U. S. Navy, Virgil began his career as an operator at the Lansing, Michigan Water Conditioning Plant. He was promoted to Superintendent in 1950.

In 1952, Mr. Langworthy resigned his position as Superintendent in Lansing, to accept an appointment as Research Chemist with the Chlorine Institute, Inc., in New York City.

In order to broaden his experience in the field as a whole, Virgil resigned from the Chlorine Institute in 1954 to become a Project Engineer for a manufacturer serving the water and sewage works field.

Rising through the ranks of industry, he was next appointed Chief Applications Engineer, then Chief Project Engineer for the water and sewage division of the company.

1959 witnessed the return of Mr. Langworthy to the editorial field,

VIRGIL W. LANGWORTHY

with his appointment as Field Editor for WATER & SEWAGE WORKS.

As many of you know, Mr. Langworthy has been a frequent contributor to WATER & SEWAGE WORKS for many years. He was the author of the series "Fundamental Principles of Chlorine Handling" that appeared in the pages of WATER & SEWAGE WORKS during 1953-54. Some of his other papers include "CO_2 Hazard is Real," and "Activated Silica Preparation by Continuous Processes."

Mr. Langworthy has also contributed technical papers to Sewage & Industrial Waste Journal, Journal New England Water Works Association, and A.W.W.A. Journal.

A member of the American Chemical Society, American Public Health Association, American Water Works Association and the Water Pollution Control Association, he has served on many local and National association committees. The most recent was the Committee on Water Resources of the State of Rhode Island.

Mr. Langworthy also currently holds the rank of Lieutenant Commander in the Naval Research Reserve.

I wish to extend my heartiest congratulations to Mr. Langworthy on his new appointment, and I have every confidence that WATER & SEWAGE WORKS will continue to be of even greater service to the field under his able direction.

Edward S. Gillette
Publisher

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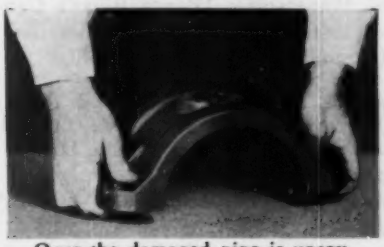
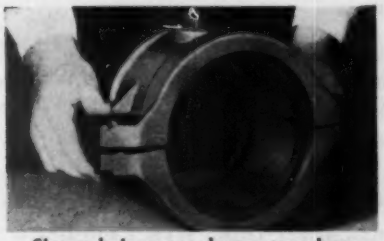
HIGH STRENGTH All parts are high tensile and corrosion-resistant. Sleeve halves are 70,000 psi tensile ductile iron. Nuts and bolts are high strength, corrosion-resistant alloy.

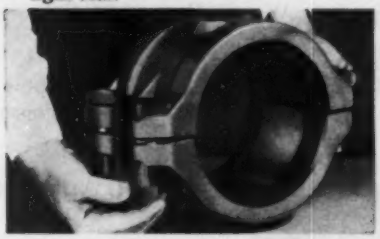
ASSEMBLED IN 3 EASY STEPS



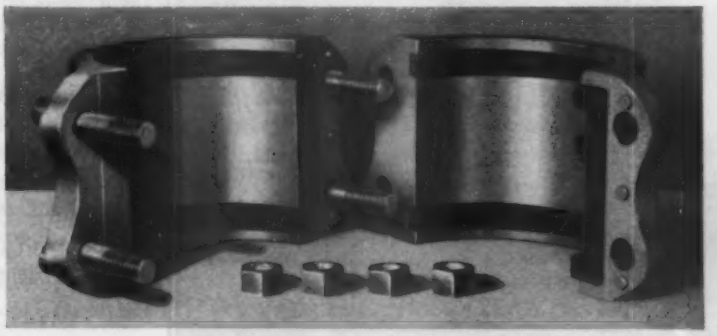
Once the damaged pipe is uncovered, one half of the sleeve is placed on each side of the pipe.



Sleeve halves are drawn together. Pre-assembled rubber gaskets make tight seal.



After the bolts are taken up finger-tight, tightening the four bolts by wrench completes assembly.



HERE'S ALL THERE IS TO IT! Illustration shows two-piece glandless construction. Side gaskets overlap ends of circumferential gaskets for tight seal. Four bolts are only accessories. Tapping boss on each half allows maximum tap of 2 inches. Regularly furnished with one sleeve-half tapped for ¾" pipe.

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CONTINUED FROM PAGE 11A

Oct. 24-26—Pittsburgh, Pa. (*Penn Sheraton Hotel*) ENGINEERS' SOCIETY OF WESTERN PA. 21st ANNUAL WATER CONFERENCE

Oct. 24-26—Colorado Springs, Colo. (*Broadmoor Hotel*) ROCKY MOUNTAIN SECTION WATER POLLUTION CONTROL FEDERATION

Oct. 24-27—Buffalo, N. Y. (*Statler Hotel*) CANADIAN SECTION WATER POLLUTION CONTROL FEDERATION

Oct. 24-27—Colorado Springs, Colo. (*Broadmoor Hotel*) ROCKY MOUNTAIN SECTION A.W.W.A. Secy., Harrison F. Kepner, Dana Kepner Co., 550 Alcott, Denver, Colo.

Oct. 25-28—Long Beach, Calif. (*Lafayette Hotel*) CALIF. SECTION A.W.W.A. Secy., F. F. Watters, Engr., State Bldg., Civic Center, San Francisco 2

Oct. 26-27—New Haven, Conn. (*Taft Hotel*) NEW ENGLAND SECTION WATER POLLUTION CONTROL FEDERATION

Oct. 26-28—Columbus, Ohio (*Deshler-Hilton Hotel*) OHIO SECTION A.W.W.A. Secy., J. Howard Bass, Henry P. Thompson Co., 1720 Section Rd., Cincinnati

Oct. 28-Nov. 2—Hawaii. CALIFORNIA SECTION A.W.W.A. 1960 MID-PACIFIC WATER WORKS CONVENTION. Write: 1960 Mid-Pacific Conference Committee, 1040 Manzanita Ave., Pasadena, Calif.

Nov. 2-4—Washington, D. C., (*Sheraton Park Hotel*) CHESAPEAKE SECTION A.W.W.A. Secy., Carl J. Lauter, 6955—33rd St., N. W., Washington, D. C.

Nov. 3-4—Omaha, Nebraska (*Castle Hotel*) NEBRASKA SECTION WATER POLLUTION CONTROL FEDERATION

Nov. 4—Columbia, South Carolina (*Jefferson Hotel*) SOUTH CAROLINA SECTION WATER POLLUTION CONTROL FEDERATION

Nov. 9-11—Winston-Salem, North Carolina (*Robert E. Lee Hotel*) NORTH CAROLINA SECTION A.W.W.A. Secy., T. Z. Osborne, Asst. Dir. of Pub. Works, Greensboro

Nov. 13-16—Fort Lauderdale, Fla. (*Galt Ocean Mile Hotel*) FLA. SECTION A.W.W.A. Secy., John G. Simmons, Plant Supt., Water Dept., West Palm Beach

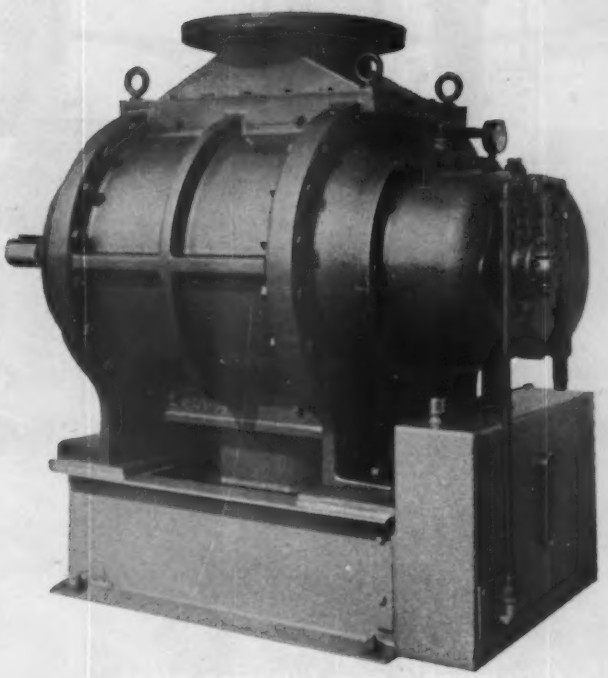
Nov. 13-16—Fort Lauderdale, Fla. (*Galt Ocean Mile Hotel*) FLA. SECTION WATER POLLUTION CONTROL FEDERATION

Nov. 16-17—Indianapolis, Ind. (*Hotel Washington*) IND. SECTION WATER POLLUTION CONTROL FEDERATION

Dec. 4-7—Washington, D. C. (*Statler Hotel*) AMERICAN INSTITUTE CHEMICAL ENGINEERS

Dec. 12-14—Washington, D. C. NATIONAL CONFERENCE ON WATER POLLUTION

NEW SUTORBILT SERIES 3200 BLOWERS DELIVER HIGHER VOLUMES IN HEAVY DUTY SERVICE



The toughest high volume air and gas handling jobs are easily handled by new Series "3200" Sutorbilt lobe-type rotary positive blowers and gas pumps. One-piece shafts, precision machined helical timing gears and the special Sutorbilt timing hub are just some of the features carefully engineered into these new units for continuous, heavy-duty service and low maintenance operation.

Rated from 800 to 20,000 cfm at pressures from 2 to 10 psi, this new line is available with timing gear diameters from 10″ to 22″. Standard equipment includes machined sub-bases, a reversible oil pump with an oversized sump that eliminates an oil cooler at ambient temperatures up to 125°F and lip-type oil seals (mechanical seals in gas and vacuum pumps) that effectively prevent leakage or gas contamination.

Write today for your free copy of illustrated bulletin giving complete specifications, Department H.

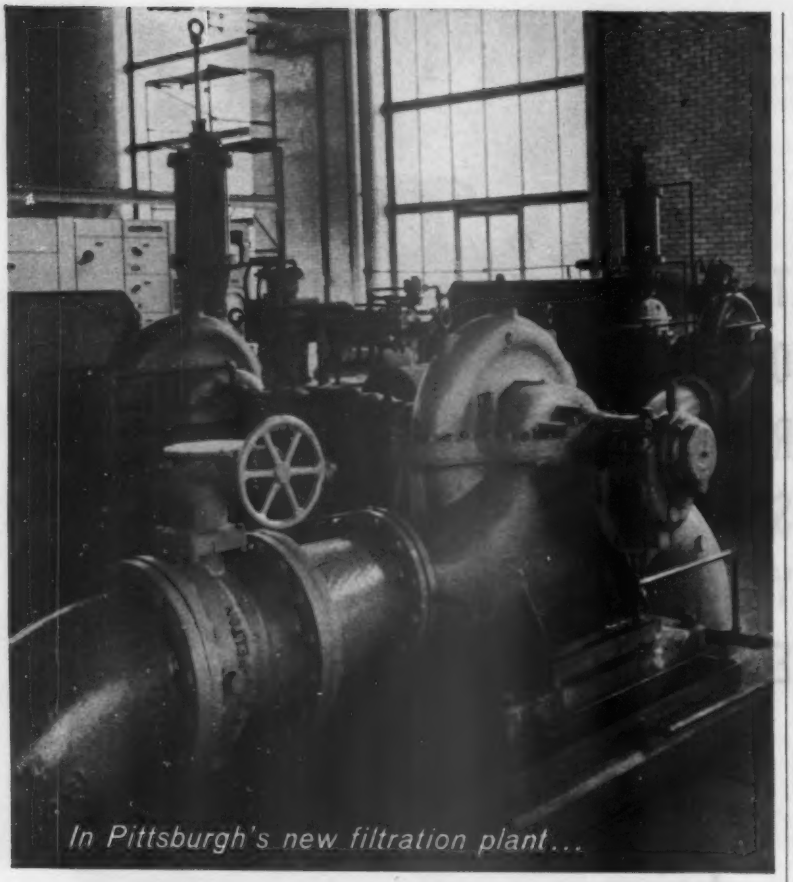
Representatives in principal cities. Consult your classified telephone directory.

2198
B29

SUTORBILT IS WELL BUILT

CORPORATION, 2966 EAST VICTORIA ST. • COMPTON, CALIF.
SUBSIDIARY OF FULLER COMPANY • CATASAUQUA, PA.

FULLER COMPANY GENERAL



DARLING VALVES

help insure "heart of the plant" efficiency

As in many another important municipal plant throughout the country, Darling Valves are on the job in Pittsburgh's new, ultra-modern filtration plant.

Sizes and types include 16" and 24" Darling-Pelton Butterfly Valves . . . and 6", 16" and 24" Darling Gate Valves with *revolving double disc parallel seats.* This exclusive Darling feature assures positive sealing and ease of operation at all times.

To insure "heart of the plant" efficiency in *your* municipal installation, specify Darling Valves. Tell us about your requirements.

DARLING VALVE & MANUFACTURING CO.
Williamsport 11, Pa.
Manufactured in Canada by
Canada Valve & Hydrant Co., Ltd., Brantford 7, Ontario

Equipment News

CONTINUED FROM PAGE 37A

Ductile Iron Pump Series

1019

Peerless Pump, Hydrodynamics Division, Food Machinery and Chemical Corp., Los Angeles, Calif., is now marketing a complete series of single and multi-stage horizontal pumps cast in Ductile Iron, thus having extreme thermal shock and corrosion resistance.

The Peerless Type A pump is a continuous duty, horizontal split case, single stage centrifugal pump. It can be applied to the widest variety of pumping jobs handling water and other liquids, even when there is a modest amount of non-abrasive solids in suspension. It is available in sizes of 4" and larger; capacities to 60,000 gpm; heads to 400 feet. All types of drives are available for this pump.

The Peerless Type TU and TUT is a horizontal, split case, multi-stage pump. It is available in two stage (Type TU) and three, four or five stage (Type TUT) design. This series of pumps is especially designed for supplying, circulating and boosting water and process liquids. Heads up to 1500 feet and capacities of up to 3000 gpm are readily handled by this pump group. All types of drives may be used.

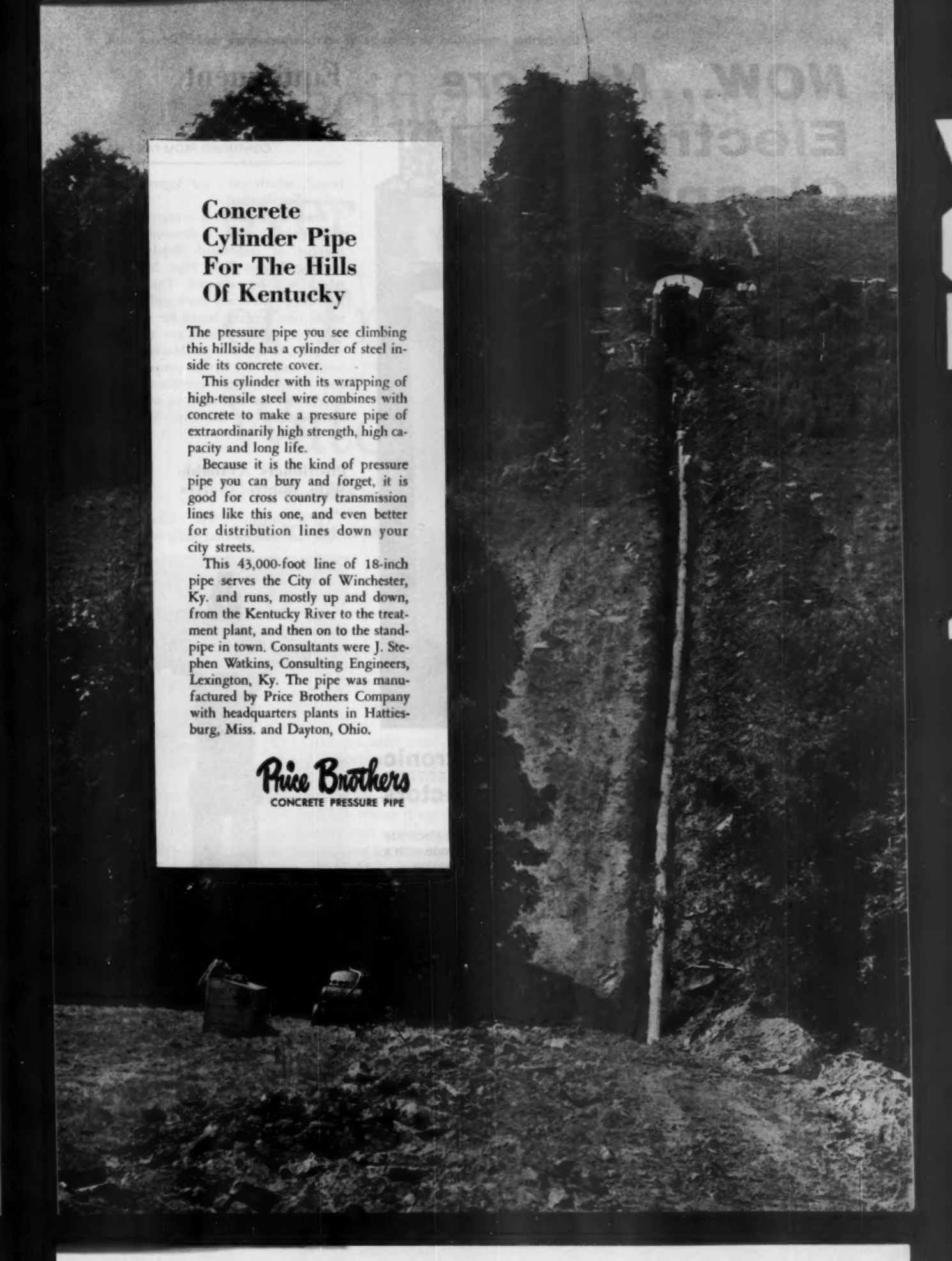
Kit Simplified Work of Marking Pipes

1020

W. H. Brady Co., Milwaukee, Wis., is offering a free kit to maintenance and safety personnel to aid in planning a standardized system for identifying piping.

The Pipe Marker Kit gives step-by-step instructions for setting up a complete, uniform marking system for pipes of all sizes. It tells which pipes must be marked for maximum safety and protection, where markings should be located to speed tracing and prevent costly errors, and how they should be marked to conform to the universally-accepted American Standards Assn., Std. A-13 "Identification of Piping Sys-

CONTINUED ON PAGE 92A



Concrete Cylinder Pipe For The Hills Of Kentucky

The pressure pipe you see climbing this hillside has a cylinder of steel inside its concrete cover.

This cylinder with its wrapping of high-tensile steel wire combines with concrete to make a pressure pipe of extraordinarily high strength, high capacity and long life.

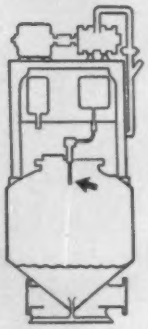
Because it is the kind of pressure pipe you can bury and forget, it is good for cross country transmission lines like this one, and even better for distribution lines down your city streets.

This 43,000-foot line of 18-inch pipe serves the City of Winchester, Ky. and runs, mostly up and down, from the Kentucky River to the treatment plant, and then on to the standpipe in town. Consultants were J. Stephen Watkins, Consulting Engineers, Lexington, Ky. The pipe was manufactured by Price Brothers Company with headquarters plants in Hattiesburg, Miss. and Dayton, Ohio.

Price Brothers
CONCRETE PRESSURE PIPE

NOW...No more Electrode Cleaning!

YEOTRONIC® brings miracle of electronic control to Yeomans Pneumatic Ejectors



Only ONE Short Sensor NO Electrode Cleaning!

YEOTRONIC control replaces the dual-electrode system and its long, troublesome electrode with a single short sensor that requires no attention.

YEOTRONIC is a major breakthrough in the electrical control of pneumatic ejectors. It is not a time-delay relay device...not a time-clock mechanism . . . but a modern transistor-operated unit designed to handle today's wastes without fouling.

YEOTRONIC is available at no extra charge on Shone®, Expelsor®, and Packex® electrically controlled pneumatic ejectors. For complete details, call your Yeomans representative or write for information.

E-6033

Another Step Forward

YEOMANS

1999-9 N. Ruby St., Melrose Park, Illinois

Equipment News

CONTINUED FROM PAGE 90A

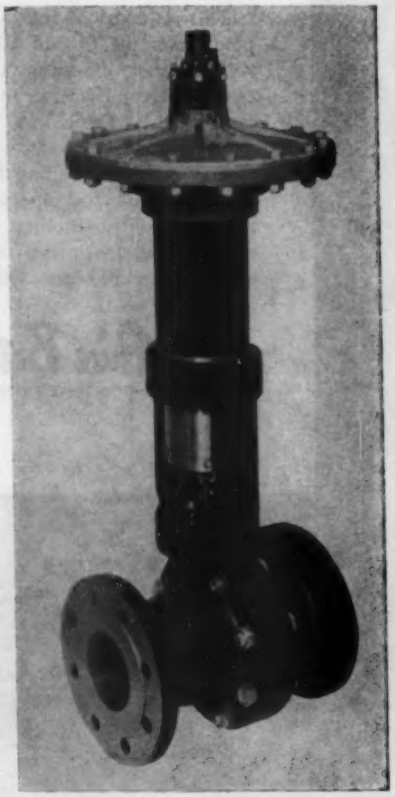
tems", which calls for legend-plus-color identification.

Each kit contains a 6-page "planning guide", used to determine the number of individual Brady self-sticking Perma-Code Pipe Markers which will be required. The guide is printed on a heavy stock and serves as its own writing board for on-the-spot use. Also included are samples of quick-to-apply Pipe Markers for testing under the actual temperature and environmental conditions for which they are intended. In addition, specifications for the Pipe Markers are included.

Positioners Available With Control Valves

1021

OPW-Jordan Corp., Cincinnati, Ohio, announces that built-in valve



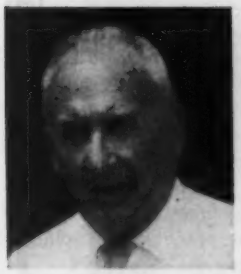
positioners for its 4" and 6" Sliding Gate Control Valves are now available from stock. When ordered as

CONTINUED ON PAGE 94A

"Specified and used over 600,000 feet of Transite Water Pipe."

A. R. Todd, Consulting Engineer,

A. R. Todd and Associates, Wheeling, W. Va.



"Transite® Pipe gives our clients distinct advantage in economy," says Mr. Todd. "It is quick and easy to install, and once in service the economies continue. That's because Transite remains unaffected by external or internal corrosion, assures a tight and flexible installation for the life of the system, protects the quality of the water it carries, and minimizes maintenance and operation costs. We have found these features to be very important in an area known for highly corrosive soils and rocky terrain.

"We have specified and used over 600,000 feet of Transite Water Pipe in the past ten years on dozens of projects. We are convinced that Transite is the best value for the money. Our clients have been well-satisfied, too."

Why not let Transite help *you* reduce community water system costs? Let us send you our "Facts and Data for Engineers" book. Write Johns-Manville, Box 14, WS-10, N. Y. 16, N. Y. In Canada: Port Credit, Ontario. Offices throughout the world. Cable address: Johnmanvil.

JOHNS-MANVILLE

Equipment News

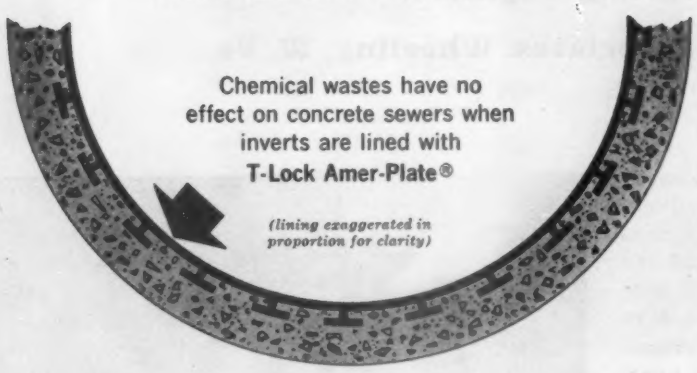
CONTINUED FROM PAGE 92A

original equipment, the positioner will be integrally mounted at the factory. Conversion kits are also available for 4" and 6" valves in the field. Field maintenance is simple and foolproof.

Positioner flow capacity: 4.4. scfm (for 3-15 psi output-pressure change); Response Level: sensitive to Controller signal changes as small as 0.1% of full range; Air Consumption: 0.22 scfm (in balanced condition, with 9 psi output).

These positioners are recommended: for large pressure drops; for fluids with high viscosity; to amplify controller signal; in high pressure applications; to sense minute controller signals; for very rapid valve response; and for split-range operation. The positioners operate on the force-balance principle, where controller air plus valve spring force are balanced against positioner air plus positioner spring force.

How to Protect Concrete Sewers from Chemical Wastes


Chemical wastes have no effect on concrete sewers when inverts are lined with
T-Lock Amer-Plate®
(lining exaggerated in proportion for clarity)

T-Lock Amer-Plate is a high polymer PVC sheet, easily cast into pipes, tunnels and structures to form a partial or complete 360° protective lining. Used in inverts, it permanently protects concrete from corrosive chemical effluents. In arch areas, it positively stops oxidized H_2S corrosion. T-Lock is also highly abrasion resistant; impartial tests show that it abrades at only 1/70th the rate of concrete.

The fact that T-Lock ends erosion and corrosion problems in industrial and municipal sewer systems is attested to by more than five million square feet now in use. Write for complete data on this maintenance-saving lining before designing your next sewer.

Applicators strategically located throughout U. S. and Canada

Amercoat CORPORATION

Dept. WJ • 4809 Firestone Boulevard • South Gate, California

821 Pitner Ave., Evanston, Ill. | 360 Carnegie Ave., Kenilworth, N. J. | 2484 Dennis St., Jacksonville, Fla. | 6530 Supply Row, Houston, Tex. | 111 Colgate, Buffalo, N. Y.

Membrane Filters

1022

Scientific Products, Evanston, Ill., have used a flexible yet sturdy cellulose material to make its S/P PartiCel Membrane Filters that provide a convenient method for the identification and counting of pathogens and bacteria in water and other fluids, gases and air samples.

Tiny uniform pores comprise more than 80% of the filter volume assuring rapid flow rate and thorough sieving action. As a sample is passed through PartiCel filter, all particles larger than the pore size of the selected membrane filter remain on the surface. Direct microscopic esamination may be made, or the filter may be placed on an absorbent pad with growth media and cultivated in petri dish. Pore sizes range from 0.2 to 10 microns.

Waste Water Analyzer Suitable for Drinking Water Tests

1023

Graver Water Conditioning Co., Division of Union Tank Car Co., New York, N. Y., has developed an automatic instrument that can indicate the level of waste impurities in plant discharge as well as in process and drinking water. Currently designed for insolubles in liquids, the instrument has potential for solubles and air sampling.

Called the Automatic Tape Analyzer, the device derives its versatility from the basic analyzing method it employes, the Millipore Filter test. In this test, particulate material is quantitatively removed from a liquid or gaseous sample by an ultra-fine millipore filter membrane and retained on the surface where it may be easily identified, sized, counted or tested.

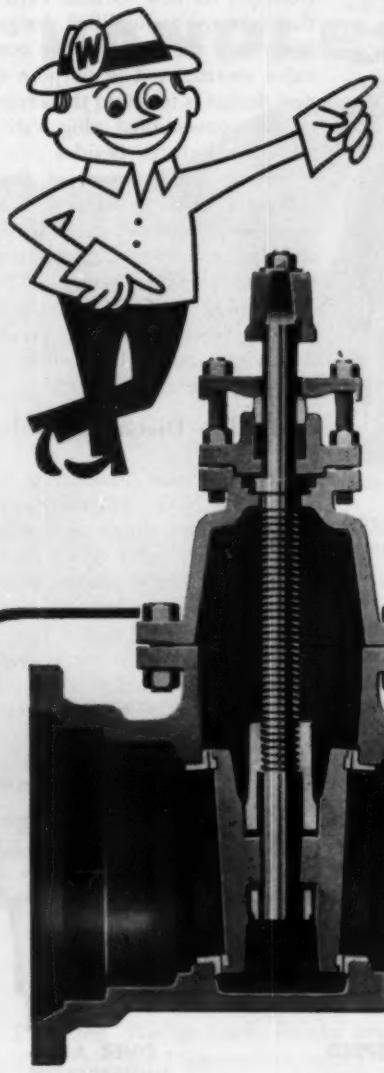
Explosion-Proof Rotary Limit Switch

1024

Gemco Electric Company, Detroit, Mich., has announced that new light weight, cast aluminum, Nema 7 enclosures now permit the housing of

CONTINUED ON PAGE 96A

THE R. D. WOOD GATE VALVE



Bury it, yes, and if R. D. Wood made it, you can just about forget it, too. There are generations of reliable service built into the R. D. Wood Gate Valve. Simple, sound design is the secret; no delicate parts to get out of order, no pockets to fill up with sediment. Even after years of idleness in the lines, R. D. Wood Gate Valves operate easily, smoothly.

ONLY THREE MOVING PARTS:

The spreader and two discs comprise the complete internal mechanism. In closing, gates are first lowered into position before spreading action begins. Then spreading pressure is distributed evenly from the hub to permit the discs to seat without distortion. Both discs are equally tight against pressure from either side of valve.

AND THESE FEATURES, TOO: Made of thoroughly seasoned castings, rigidly inspected and tested to 300 pounds hydrostatic pressure. Available with bell, mechanical joint or flange pipe connections; conventional or "O" ring packings.

Conform to latest AWWA specifications

R. D. WOOD COMPANY

Public Ledger Building, Independence Square, Philadelphia 5, Pa.

Manufacturers also of Mathews Modernized Hydrants, Mathews Flange Barrel Hydrants, R. D. Wood Hydrants, and "Sand-Spun" Pipe (centrifugally cast in sand molds)

Equipment News

CONTINUED FROM PAGE 94A

Rotary Limit Switches with gear ratios ranging from 5:1 to 1750:1. Positive independent cam settings allow adjustments of one cam without upsetting the position of the other.

U/L approved Micro Switches have single pole, double throw, contacts for reversibility of control circuits. The switch is rated at 125 Volt, 250 Volt and 460 Volt, 15 Amp., A.C., 125 Volt, ½ Amp. D.C., 250 Volt, ¼ Amp. D.C. Self-lubricating, powdered metal impregnated bearings give lifetime lubrication.

Safety Switches For Maximum Protection

1025

American Electric Switch Division, The Clark Controller Co., Cleveland, Ohio, has incorporated important design features in its new safety switch. These include: visible double blade construction; positive, quick make and quick-break operation; double insulation between blades and operating mechanism; optimum-size enclosures for maximum heat dissipation; plenty of wiring space for easier, faster installation; and an exclusive safety-yellow operating handle for quick "spotting" even in poor light.

The unit meets NEMA Standards for normal duty industrial and commercial use and is approved by U. L. for these applications as well as for service entrance equipment. It is currently available in 30-ampere and 60-ampere, 250 and 600 volt ratings, both fusible and non-fusible.

Curb Valve Has Simplified Design

1026

Mueller Co., Decatur, Ill., has introduced its new Oriseal curb valve that features a simplified design utilizing only six parts for the complete valve assembly. The purpose of the new design is to retain the advantages of the conventional plug valve and add new features besides.

Among the features of the new valve are: straight-through flow construction; protected valve seats; top and bottom "O" rings; a straight, balanced pressure plug; a Teflon-coated plug to eliminate sticking and freezing, even after long periods of inactivity; and no lubrication or periodic maintenance design.

Peristaltic Discharge Valve

1027

U.S. Hoffman Machinery Corp., New York, N. Y., has made available a new, rubber diaphram peristaltic type discharge valve which makes it possible to handle coarse abrasives such as catalysts, pellets and other odd shaped materials unable to pass through conventional rotary valves.

The valve's elliptical body and the

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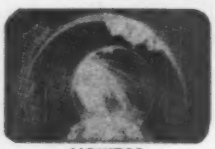
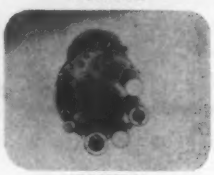
TELEVISION
FOR PIPE INSPECTION



MONITOR



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Pin point trouble spots with our completely automatic Video System.

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Positive visual observation and repair automatically upon location.

• PERMANENT RECORDS
Technician in our mobile viewing room makes permanent records of conditions.

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RA 1-7555

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Cleveland 6, Ohio

SPEED SENSITIVE
1, 2 & 3 ELEMENT
SWITCHES

OVERSPEED
One S.P.D.T. switch to trip at speeds between 500 and 6,000 RPM.

OVER AND UNDERSPEEDS
Two S.P.D.T. switches to trip at two different speeds between 300 and 6,000 RPM.

UNDERSPEED
One S.P.D.T. switch to trip at speeds as low as 250 RPM. Maximum operating speed 5,000 RPM.

OVER INTERMEDIATE AND UNDERSPEED
Three S.P.D.T. switches to trip at three different speeds between 350 and 6,000 RPM.

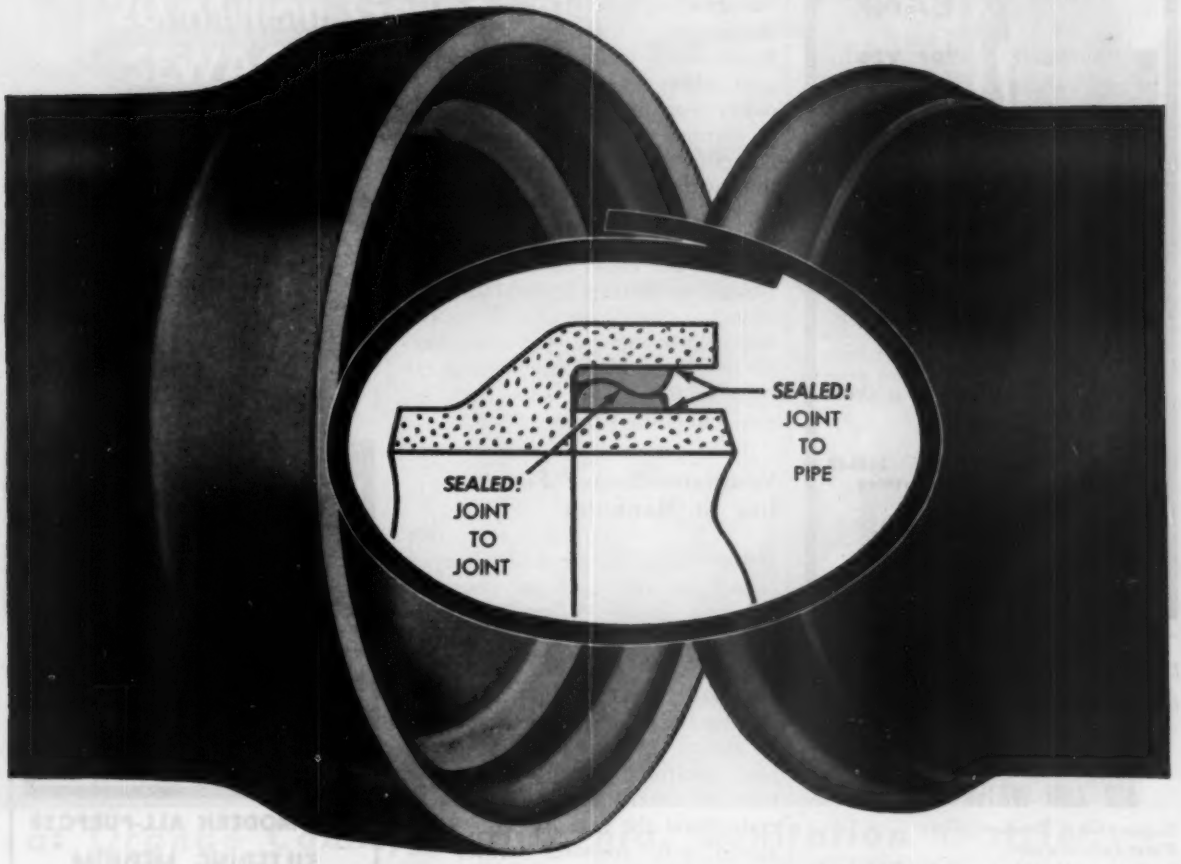
EXPLOSION PROOF AVAILABLE
The switches listed above are available with explosion proof containers that meet all of the specifications of Class 1, Group D, explosion proof equipment.

For further information ask for Bulletin 504 and 504 A.

SYNCHRO-START PRODUCTS, INC.
8151 N. RIDGEWAY AVENUE, SKOKIE, ILLINOIS

Wedge-Lock®

HANDLES INFILTRATION!



ROOT-TIGHT SEAL!

Patented Wedge-Lock Joints are bonded to Vitrified Clay Pipe—*at the factory*—to bring you the highest performance standards . . . the lowest installation costs.

One simple, easy operation and the joint's tightly sealed around the full pipe circumference . . . stays in continuous compression for the life of the pipe. When you specify Wedge-Lock, you reduce infiltration and resist root problems before they start . . . keep installation costs down . . . benefit from the guaranteed performance of the world's longest-lasting pipe.

MINIMUM INFILTRATION!

Write to listed manufacturers for literature or an actual Wedge-Lock demonstration

Wedge-Lock CLAY PIPE

THE FACTORY-JOINTED CLAY PIPE AVAILABLE NATIONALLY FROM LOCAL MANUFACTURERS

Order Wedge-Lock from any of these Vitrified Clay Pipe Manufacturers:

Cannelton Sewer Pipe Company....Cannelton, Ind.
The Clay City Pipe Company....Uhrichsville, Ohio
Graff-Kittanning Clay Products..Worthington, Pa.
Larson Clay Pipe Company.....Detroit, Mich.
Lehigh Sewer Pipe & Tile Company..Ft. Dodge, Ia.
The Logan Clay Products Company....Logan, Ohio
The Owensboro Sewer Pipe Co.....Owensboro, Ky.
Pomona Terra-Cotta Company..Greensboro, N.C.
The Robinson Clay Products Co.....Akron, Ohio
Superior Clay Corporation.....Uhrichsville, Ohio

90% cut in operating and maintenance cost means

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New, transistorized M-SCOPE PIPE FINDER only $189.50

Rugged, transistorized construction practically eliminates maintenance costs . . . extends battery life to a year or more. Pinpoint accuracy, greatest depth penetration make the M-Scope first choice in the field!

New, Heavy Duty LEAK DETECTOR $295.00

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Equipment News

CONTINUED FROM PAGE 96A

"sandwiching" of its sheet rubber diaphragms insure positive closure. Movement is confined to the valve's gum rubber diaphragms which alternately open and close by air pressure or vacuum. This action permits discharge of materials in measured quantities with 100% air tight seal. There are no internal wearing metallic parts in this valve, and its rubber diaphragms are easily replaced.

Another feature is its "fail-safe" operation. Should either of the rubber diaphragms rupture, the other diaphragm is capable of extending to the opposite side of the valve for complete and positive closure.

Ventilator-Heater For Use in Manholes

1028

Morrison-Pelsue Co., Denver, Colo., has developed an improved ventilating heater designed for manhole and other underground use.

This Model PE-G is a 78 pound portable ventilator and heater with an attached 300 watt generator for an electric light or soldering iron. A new waterproof weatherguard protects the electric outlets on the generator, and the case has been redesigned with rounded corners for added safety and general streamlining. The stainless steel heat exchanger is fabricated with continuous welded seams.

The unit's Briggs & Stratton engine has been converted to propane carburetion. The unit itself delivers from 300 to 800 cubic feet per minute of fresh heated air. This heated air passes through the heat exchanger, and all products of combustion pass into the atmosphere through the burner exhaust so that only safe fresh, heated air is forced into the manhole area.

The PE-G is equipped with a forced draft burner which has an input rating of from 10,000 to 45,000 BTU's per minute with a 98° temperature rise. It is designed for year around ventilation, delivering heated fresh air in winter and fresh air only in summer when operated as a blower.

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MECHANICAL EQUIPMENT BY ROBERTS FILTER MFG. CO. DARBY, PENNA.

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Trade Mark Reg. U.S. Pat. off.

THE MODERN ALL-PURPOSE FILTERING MEDIUM

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DOUBLES length of filter runs.
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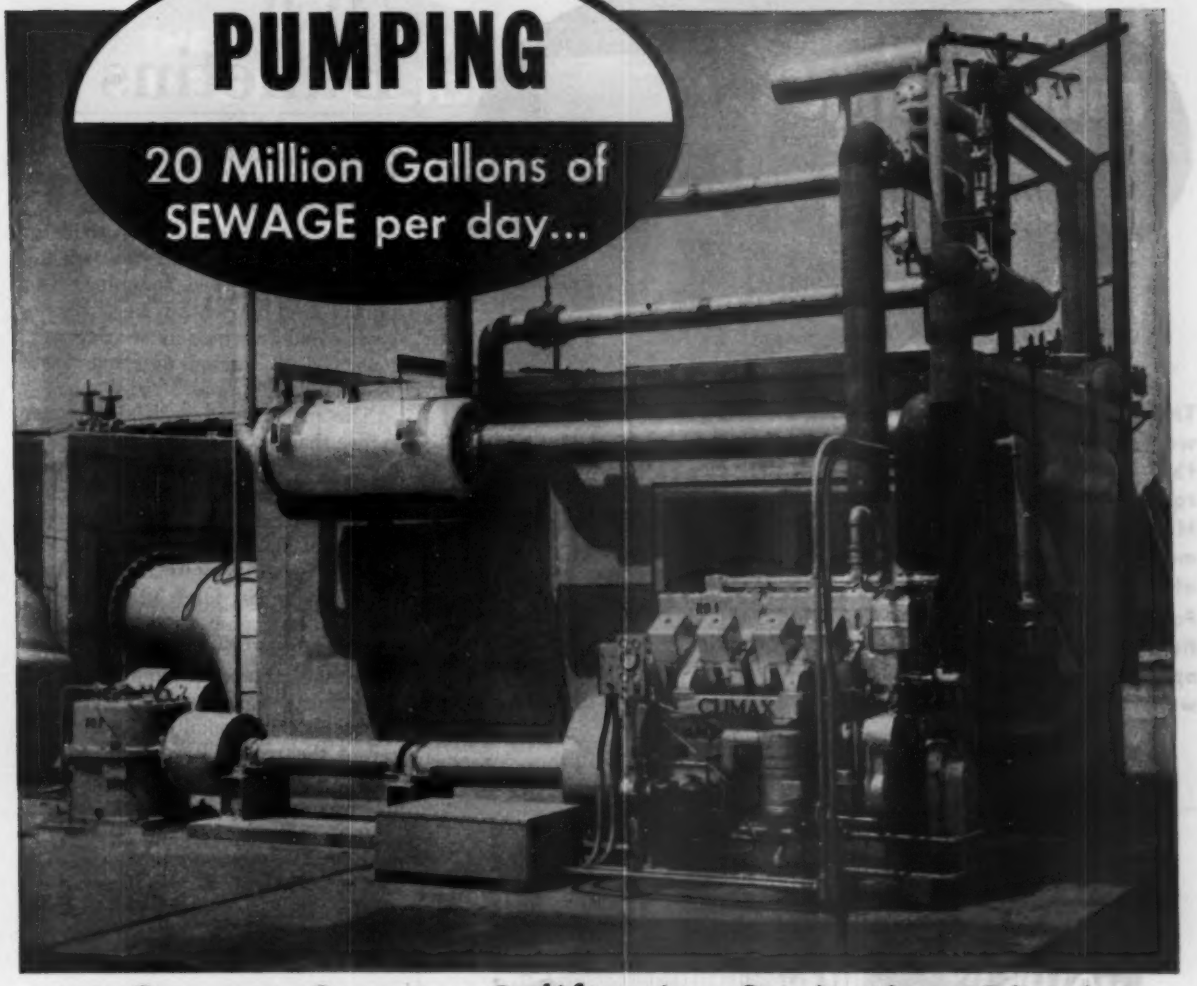
20 Million Gallons of SEWAGE per day...



at Orange County, California, Sanitation District

two CLIMAX V-85 ENGINES *power the pumps*

Driving centrifugal pumps, two Climax V-85 Engines running at 775 rpm, pump approximately 20 million gallons of sewage per day in Plant No. 1 of the County Sanitation Districts of Orange County, Calif., at Ellis and Verano Streets, Santa Ana. These V-85 Climax Engines —8-cyl., 7½-in. bore x 7-in. stroke, 2474 cu. in. displacement—are burning sludge gas from the digesters; when this gas is not available the engines are automatically switched over to butane fuel. They operate with vapor phase cooling, and the waste heat is used in the digesters. The Climax V-8, unusually compact in design, packs more power into less space. Rugged, too, for durability with dependability in continuous duty sewage plant service. Its famous fuel economy is built-in. For all its plus-value features in detail, get Bulletin SA-584.

CL-109

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FACTORY—CLINTON, IOWA

PRATT
Monoflange
Mark -II
the versatile valve

THE IDEAL VALVE for many waterworks applications in the 0-150 psi pressure range. Sizes 4" thru 20". Manual, cylinder, electric motor and diaphragm actuators.

For complete description, fluid and gas flow data, operator sizing, and prices, write for Bulletin 10-B.

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New Bulletins

Solids-Contact Reactors

1029

Cochrane Corp., Philadelphia, Pa., has issued a revised 20-page bulletin discussing solids-contact reactors for water clarifying and softening. The publication has many new photographs and drawings illustrating various types of reactors and their basic design considerations.

The principle of radial horizontal rather than upflow as an aid to complete settling of fine precipitates and clarifying is explained in the bulletin. Illustrations show how the reactor is constructed as a package unit divided by baffles into reaction and clarifying zones. High turbulence in the reaction zone promotes mixing of water and chemicals and preforming large settleable precipitates. In the clarifying zone above, water and slurry flow horizontally from the center of the reactor at decreasing velocity. Slurry settles by efficient downflow to a concentrator area. Slurry carry-over into the effluent is thereby avoided.

The bulletin also contains information on chemical feeds and auxiliary equipment and lists many applications for solids-contact reactors.

Liquid Level Gauges and Valves

1030

Jerguson Gage and Valve Co., Burlington, Mass., has issued an 8-page catalog that covers the company's line of liquid level gauges and valves. Intended for easy useage, the publication presents a condensed listing of the equipment's most pertinent data and specifications.

Also included in the literature are dimensional drawings, photographs, illustrations and descriptions of construction features, pressure-temperature graphs and ratings.

Pipe Line Supplies and Specialties

1031

R. H. Baker and Co., Inc., Los Angeles, Calif., has made available its recent catalog that lists and describes

CONTINUED ON PAGE 102A

No. 6 OF A SERIES

THE FACTS ABOUT
FRESH SOLIDS
DEWATERING

...SLUDGE
CONDITIONING

Successful fresh solids dewatering depends upon proper chemical conditioning to produce the most filterable sludge, comparatively low in bacterial count and free from nuisance in disposal.

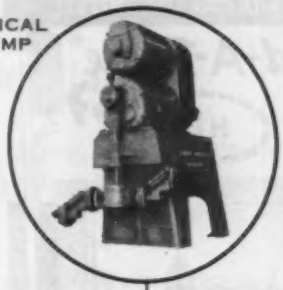
The functions of chemical conditioning are to achieve maximum coagulation, with minimum chemical usage. The chemical feed must be co-ordinated to the sludge flow and the chemicals must be adequately mixed with the sludge to provide optimum filtration rate. Komline-Sanderson has developed and installed over 250 K-S Lime Slurry pumps to feed slurry to Coilfilters. The K-S Chemical Feed pump handles ferric chloride successfully, positively, with assured long life. Both pumps are of dual valve design.

Proper mixing involves intimate contact with the sludge, realizing that the viscosity and solids content change during the filter run. Gentle agitation during a controlled detention period is provided by the new stainless steel Komline-Sanderson Rotating Conditioning Tank with variable speed drive—result—proper mixing of chemicals with the sludge.

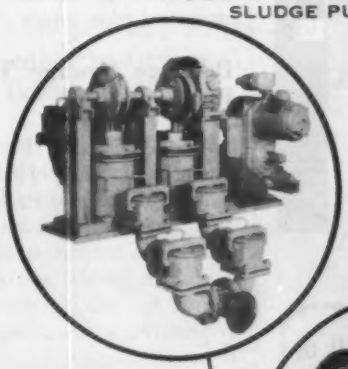
Proved Komline-Sanderson Sludge Pumps, ruggedly constructed, with dual valve design, are installed with all Coilfilters to provide positive pumping of sludge.

Komline-Sanderson chemical feeders, sludge pumps and rotating sludge conditioning tanks are designed to perform as an integrated team. When coupled with a non-clog, non-blind COILFILTER, the success of the fresh solids dewatering installation is assured. You can depend on Komline-Sanderson equipment, by far the most widely used in fresh solids dewatering sewage treatment plants.

K-S CHEMICAL FEED PUMP

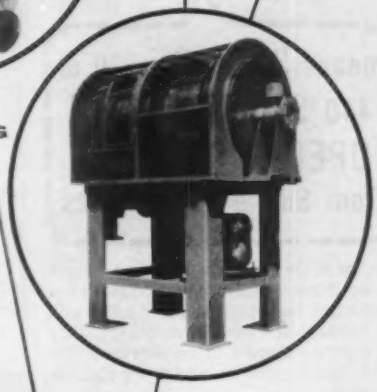


K-S DUAL VALVE SLUDGE PUMP

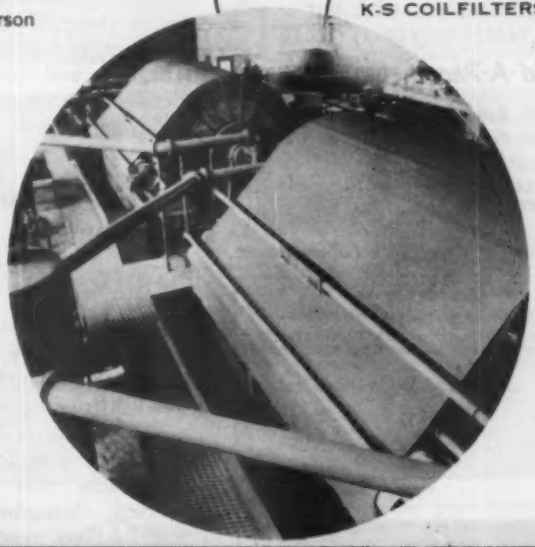


K-S LIME SLURRY PUMP

K-S SLUDGE CONDITIONING TANK



K-S COILFILTERS



KOMLINE-SANDERSON ENGINEERING CORPORATION
PEAPACK, NEW JERSEY • BRAMPTON, ONTARIO, CANADA

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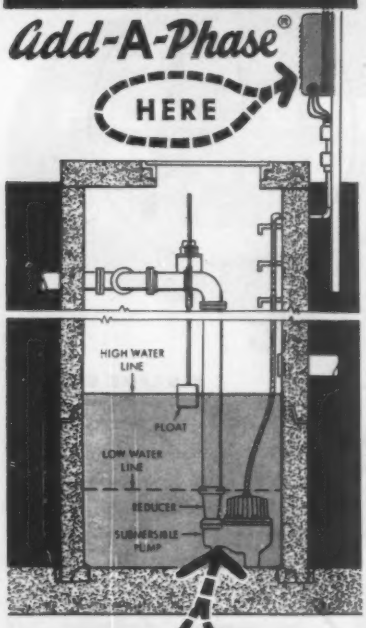

means 3-PHASE 220 or 440 SUBMERSIBLE OPERATION HERE from Single Phase Lines

Now, get all the benefits of dependable 3-phase submersible pump operation and be assured of trouble-free, continuous full power output with the ADD-A-PHASE Power Converter. Absolutely no expensive 3-phase wiring necessary. The Add-A-Phase is easily installed by any qualified electrician.

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SEE FOR YOURSELF . . . package includes many case histories of the success of the Add-A-Phase . . . years of trouble free use. IF YOU HAVE A SPECIFIC ELECTRIC POWER PROBLEM GIVE US THE DETAILS FOR RECOMMENDATION.

New Bulletins

CONTINUED FROM PAGE 100A

the company's line of pipe line fittings, supplies and specialties.

The various items are separately presented in bulletin form and all are both described and illustrated. A special feature of the publication is a metal cutting chart for the company's universal pipe repair clamps.

Package Sewage Treatment Plants

1032

Walker Process Equipment, Inc., Aurora, Ill., has published a 12-page bulletin describing its Sparjair package sewage treatment plants that utilize the contact stabilization process. The plants are especially designed for installations where space requirements are a major consideration.

The bulletin contains many on-the-job photographs and both installation and operational diagrams.

Electric Check Valves

1033

Golden-Anderson Valve Specialty Co., Pittsburgh, Pa., has released a new 8-page bulletin that describes the company's electric, double-cushioned, check valve used basically on pump installations.

The operation of these units, especially designed to eliminate water hammer, is described and illustrated. Diagrams and charts show the unit's performance characteristics and construction features. Sizes of the valves range from 2" to 36".

Steel Reservoirs and Standpipes

1034

Chicago Bridge and Iron Co., Chicago, Ill., has recently published a new 20-page bulletin that explains the function of ground storage structures use in municipal and private water distribution systems.

The bulletin is liberally illustrated showing photographs of on-the-job installations that have been constructed throughout the country. Specifications, standard capacities and maintenance recommendations are also included.

CONTINUED ON PAGE 108A

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★ flexibility

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64 JEFFREY Chemical Mixing units at Chicago's new Central District Filtration Plant

Sixteen chemical mixing basins, equipped with 64 Jeffrey mixing units, will serve the "world's largest municipal water filtration plant" when it goes into operation in 1962. Each basin has a rated capacity of 60 million gallons per day, giving this plant a daily capacity of 960 mg.

Jeffrey equipment has seen years of service in other Chicago water and sewage treatment plants. It has proved its worth and dependability here, as well as in hundreds of other plants throughout the country—small plants as well as large.

Jeffrey's Sanitary Engineers offer help on problems involving plant layout and equipment. Bulletin 952 describes these services. The Jeffrey Manufacturing Company, 996 North Fourth Street, Columbus 16, Ohio.

Air view of the Central District Filtration Plant under construction.

A model showing what the plant will look like when completed.

CONVEYING • PROCESSING • MINING
EQUIPMENT...TRANSMISSION MACHINERY...
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JEFFREY

NASSAU, N. Y. - 70 DeZurik Valves; HUNTINGTON BEACH, Calif. - 67 DeZurik Valves; OXNARD, Calif. - 61 DeZurik Valves; WALLINGFORD, Conn. - 98 DeZurik Valves; RAYTOWN, Mo. - 90 DeZurik Valves; PRESQUE ISLE, Maine - 88 DeZurik Valves; DAVENPORT, Ia. - 60 DeZurik Valves; PRINCESS ANNE, Va.- 261 DeZurik Valves; ROCKAWAY PLANT, New York City - 157 DeZurik Valves; BIJOU, Calif. -168 DeZurik Valves; MOUNT AIRY, N.C.-138 DeZurik Valves; WASHINGTON, D.C.- 156 DeZurik Valves; WATSONVILLE, Calif. - 110 DeZurik Valves; HAMMOND, Ind.- 192 DeZurik Valves; BERGEN COUNTY, N. J.- 90 DeZurik Valves; ASHLAND, Ky. - 141 DeZurik Valves; BENNINGTON, Vt. - 86 DeZurik Valves; ORANGEBURG, N.Y.- 60 DeZurik Valves; FREEPORT, L. I., N. Y. - 107 DeZurik Valves; GREENSBORO, N. C. - 130 DeZurik Valves; FORT WAYNE, Ind. - 89 DeZurik Valves

WHY DO THESE CITIES - and hundreds of others - CHOOSE DeZURIK VALVES for their sewage treatment plants?

BECAUSE—DeZurik Valves operate easily due to corrosion resistant bearing bushings; they won't "freeze up," even after long periods of inoperation!

BECAUSE—DeZurik stem bearings are minimal diameter consistent with the required strength; there's less friction, lower operating torque, years of trouble-free service!

BECAUSE—DeZurik's leak-proof stem seal is self-adjusting, with multiple surfaces in contact with the stem for longer life without leakage!

BECAUSE—DeZurik Valve stems can be repacked without shutting down the service under normal sewage plant pressures!

And there are other advantages, other reasons why more and more consultants choose DeZurik Valves. Their compact size, their light weight, their *long record of successful installations* . . . . these are just a few! Get the full story in Booth 127 at the FSIWA Convention in Philadelphia, see the DeZurik representative in your area, or write to

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SARTELL, MINNESOTA

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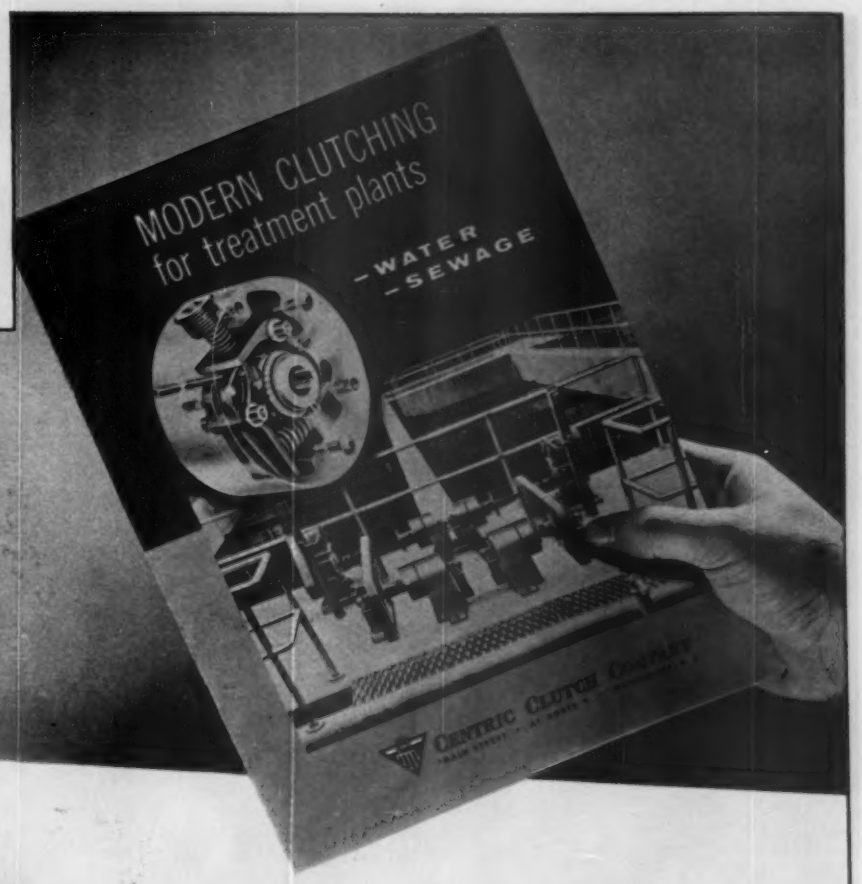

CENTRIC'S NEW BULLETIN SPECIFICALLY FOR TREATMENT PLANTS TELLS HOW TO PREVENT COSTLY DAMAGES FROM OVERLOADED DRIVES

See how more and more water and sewage treatment plants are saving thousands of dollars by installing CENTRIC TRIG-O-MATIC OVERLOAD RELEASE CLUTCHES in their flight bar and cross-collector drives.

See how the TRIG-O-MATIC is easily adapted to various types of drives to give instantaneous overload protection along with a power shut-off feature which effectively prevents damage until the cause of trouble is removed — then how normal operation is resumed by simply re-engaging the clutch.

SEE HOW DRIVES CAN BE LAID OUT FOR VARIOUS TYPES OF INSTALLATIONS.

SEE TYPICAL TYPES OF CLUTCH ADAPTIONS COMPLETE WITH DETAILED DRAWINGS AND DIMENSIONS PERTAINING TO THE INSTALLATION REQUIRED.

SEE DETAILED DIMENSIONS OF THE NEW LIMIT SWITCH ACTUATOR MECHANISM & ITS ADAPTABILITY.

Free copies of Bulletin 305 are available.

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Also manufacturers of the well known Centric Centrifugal Clutch-Couplings.

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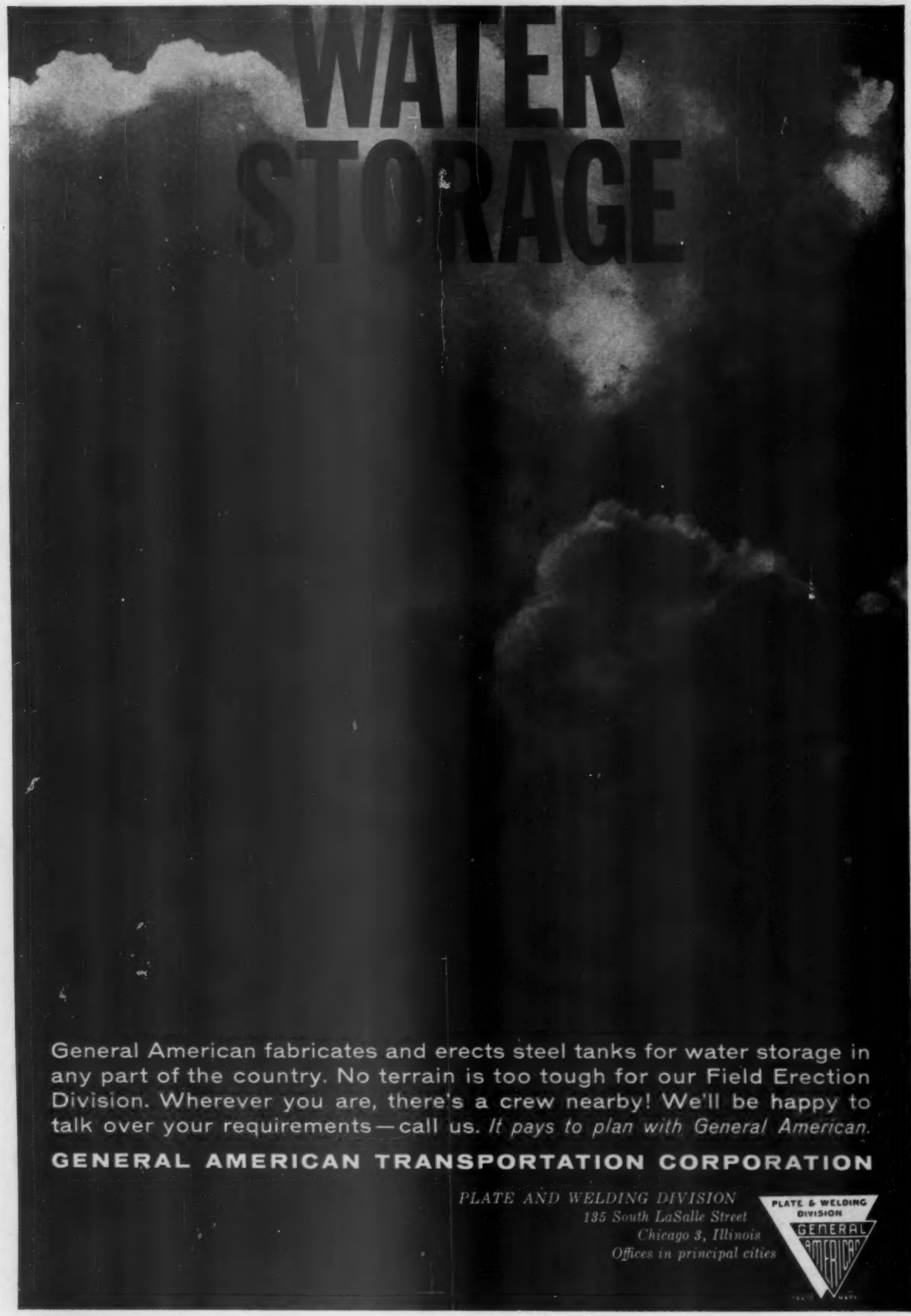

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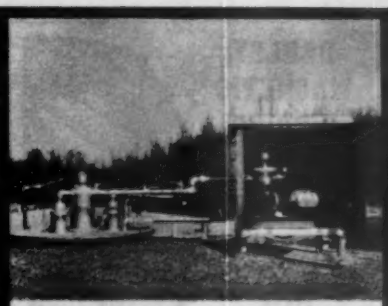
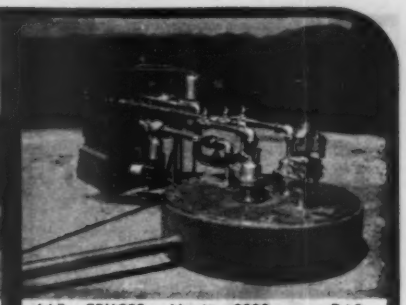
ROCKFORD, ILL.—Three GASLIFTERS in existing digesters. Henry Riedesel, Mgr., San. Dist. Greeley and Hansen, Chicago, Cons. Engrs.



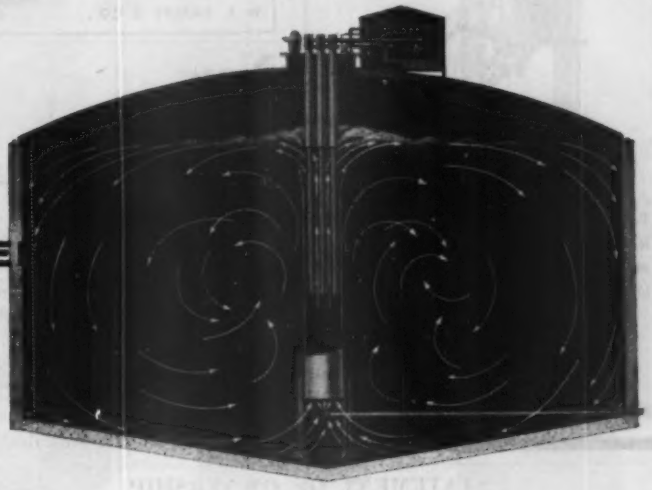
GREENSBORO, N. C.—GASLIFTER in existing 75' dia. digester with floating cover. Dan Holder, Supt. City of Greensboro, Engrs.



LAS CRUCES, N. M.—8000 gpm GASLIFTER in 50' dia. digester with fixed cover. R. A. Smith, Supt. Gordon Herkenhoff & Assoc., Albuquerque, Cons. Engrs.

GASLIFTER

DIGESTER CIRCULATOR - MIXE



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GASLIFTERS incorporate the patent right of Joseph Cunetta.

NO INACTIVE ZONES—permits utilization of entire digester capacity allowing higher loading rate.
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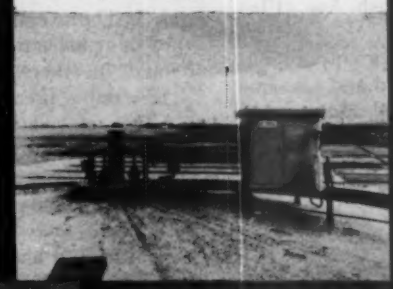
SALT LAKE COUNTY, UTAH—(Suburban San. Dist.)—12,000 gpm GASLIFTER in 60' dia. digester. Emil Meyers, Supt. Caldwell, Richards & Sorensen, Inc., Salt Lake City, Cons. Engrs.



AURORA, ILL.—10,000 gpm GASLIFTER in existing 50' sq. digester. Williard P. Pfeiffer, Supt. W. E. Deuchler, Assoc., Inc., Aurora, Cons. Engrs.

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New Bulletins

CONTINUED FROM PAGE 102A

How To Judge Engine Quality

1036

Caterpillar Tractor Co., Peoria, Ill., has published an 8-page handbook entitled, "Judging Engine Quality" intended as a guide for those responsible for machinery engine purchase. The book emphasizes the features of the various designs.

WATER PRODUCTION SUPERINTENDENT

The City of Miami Civil Service Board is accepting applications from qualified applicants in order to establish a register for an immediate opening for a Water Production Superintendent in the Department of Water and Sewers. The in-hiring rate of pay is $685.00 per month. The maximum of this range is $842.00 per month, which is normally reached in five annual increments based on a satisfactory service record.

Education and Experience: B.S. degree in Sanitary Engineering or in Mechanical, Electrical or Civil Engineering with courses in Sanitary Engineering plus at least eight (8) years experience in a responsible supervisory capacity in the operation and maintenance of large water treatment plants and pumping stations.

Please send a complete summary of your education and experience including also your college transcript and a photostatic copy of your military service discharge for Veterans preference points to Henry W. Korner, Executive Secretary, City of Miami Civil Service Board, 3318 Pan American Drive, Miami 33, Florida. The closing date for receiving completed applications is Nov. 16, 1960.

STATEMENT OF OWNERSHIP

Statement required by the Act of August 24, 1912, as amended by the Acts of March 3, 1933, July 2, 1946 and June 11, 1960 (74 Stat. 208) showing the ownership, management and circulation of

Water & Sewage Works

published 13 times yearly at Pontiac, Illinois, for October, 1960.

1. The names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Edward Scranton Gillette, 185 North Wabash Ave., Chicago 1, Illinois; Editor, Edward Scranton Gillette, 185 North Wabash Ave., Chicago 1, Illinois; Managing Editor, Fred C. Maurer, 185 North Wabash Ave., Chicago 1, Illinois.

2. The owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding 1 percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as that of each individual member, must be given.) Scranton Publishing Co., Inc., 185 North Wabash Ave., Chicago 1, Ill.; Edward S. Gillette, 185 North Wabash Ave., Chicago 1, Ill.; Claribel T. Gillette, 185 North Wabash Ave., Chicago 1, Ill.

3. The known bondholders, mortgages, and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: None.

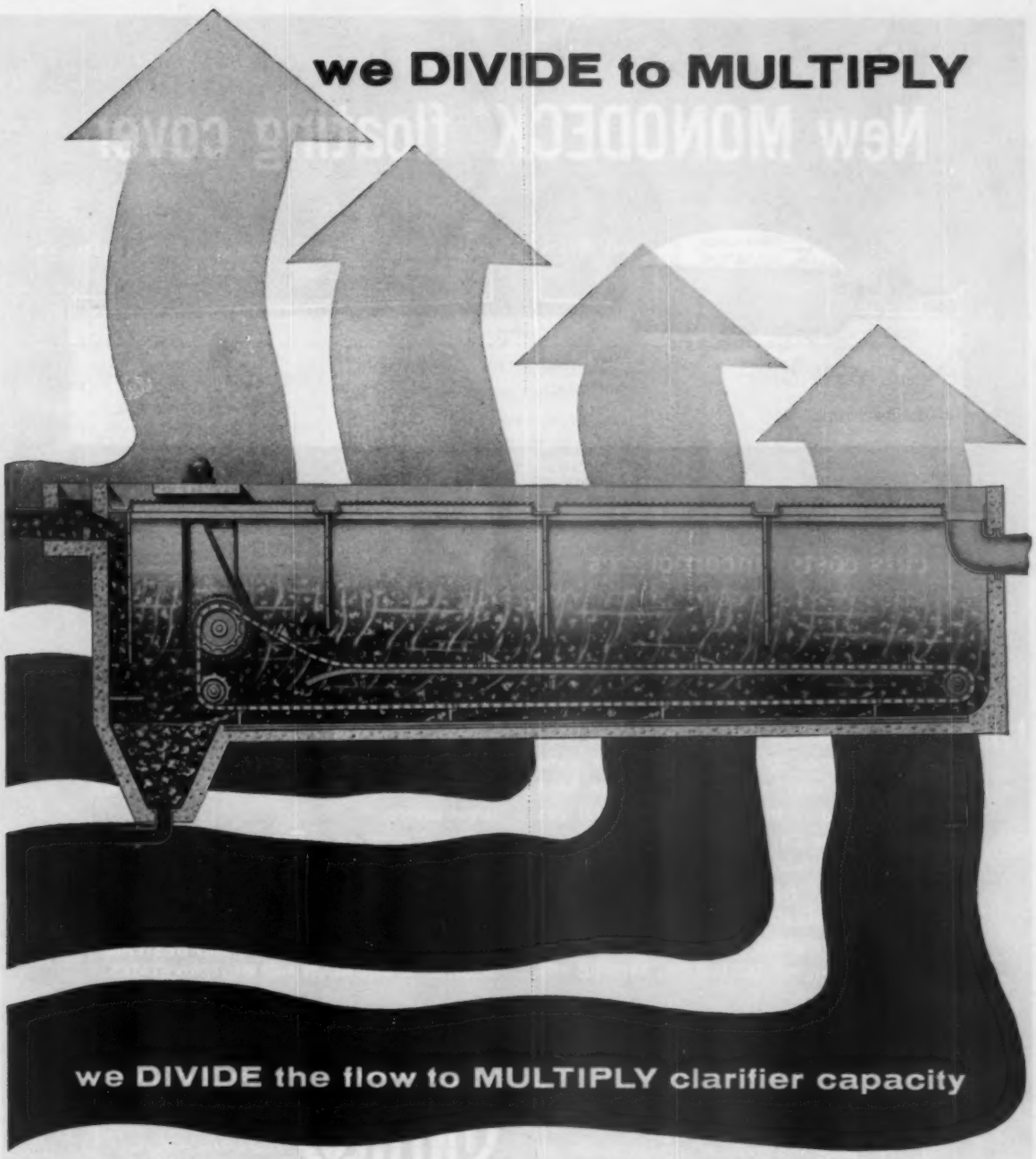
4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

5. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was: (This information is required by the act of June 11, 1960 to be included in all statements regardless of frequency of issue.) 8,897.

Edward S. Gillette, Publisher

Sworn to and subscribed before me this 12th day of September, 1960. Helen Buford Hoppe, Notary Public. (My commission expires March 19, 1964.)

we DIVIDE to MULTIPLY



Rex Verti-Flo not only increases the clarifying capacity of tanks up to four times; it provides a far clearer effluent. The savings in equipment and construction costs are obvious. Here's how Verti-Flo does it: The unique design of Rex Verti-Flo Clarifier transforms the conventional horizontal-flow tank into a vertical-flow tank...utilizing the *full volume* of the tank and *minimizing short-circuiting*. This is accomplished by a system of collecting troughs, weirs and partitioning baffles which divide the large, horizontal settling zone into a series of small, vertical-flow cells. To assure maximum flow length and control, the weirs are adjustable entirely around the periphery of each cell.

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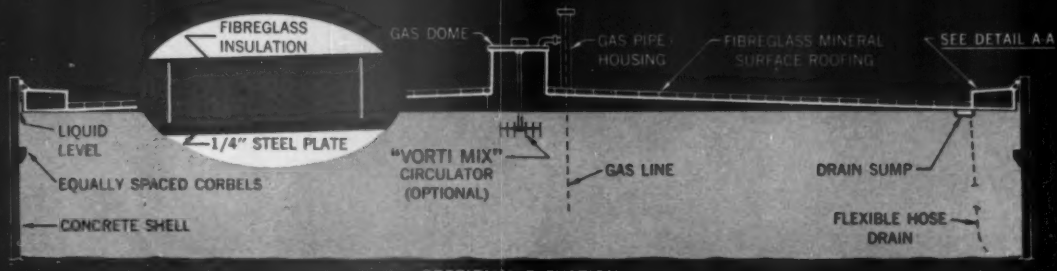
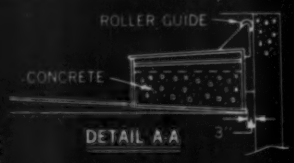


SECTIONAL ELEVATION



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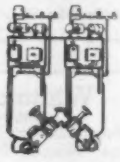

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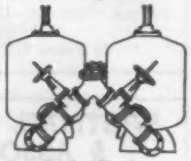

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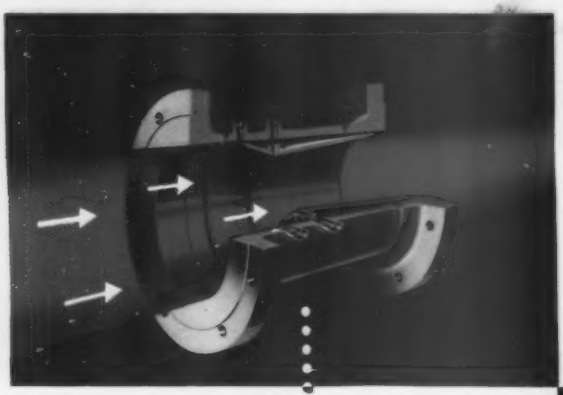

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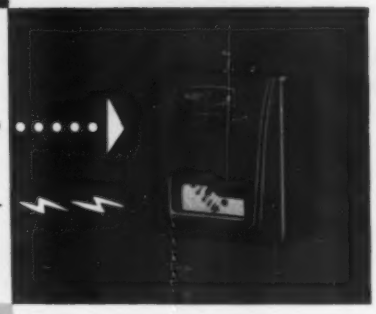

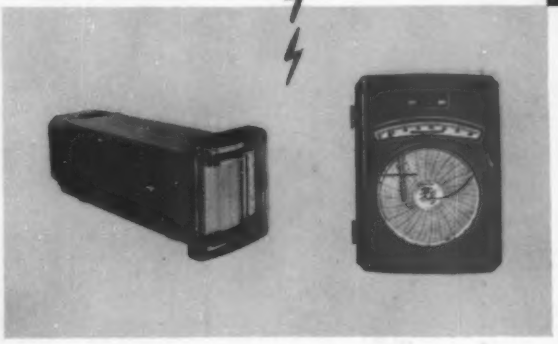

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